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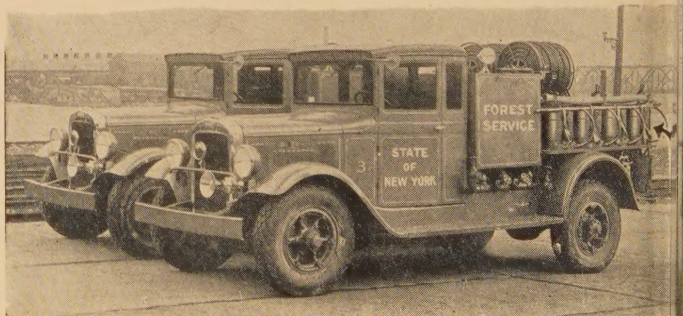
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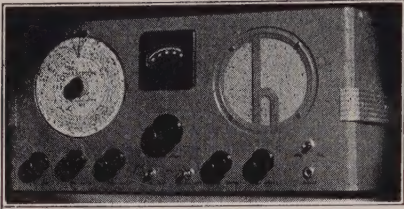
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EDITORIAL

A SIGNIFICANT FORESTRY DOCUMENT

ON March 14, 1938, President Roosevelt, in special message to the Congress requested that body to set up a joint committee to study the forest land problem of the United States. The President asked that this committee give particular consideration not only to the situation with respect to private forest lands but also to such matters as:

“1. The adequacy and effectiveness of present activities in protecting public and private forest lands from fire, insects, and diseases; and of cooperative efforts between the federal government and the states.

“2. Other measures, federal and state, which may be necessary and advisable to insure that timber cropping on privately owned forest lands may be conducted as continuous operations, with the productivity of the lands built up against future requirements.

“3. The need for extension of federal, state, and community ownership of forest lands, and of planning public management of them.

“4. The need for such public regulatory controls as will adequately protect private as well as the broad public interests in all forest lands.

“5. Methods and possibilities of employment in forestry work on private and public forest lands, and possibilities of

liquidating such public expenditures as are or may be involved.”

The President did much more than ask this joint committee to study these basic forest problems; he asked that they be studied with a view to taking “definite action” by the Congress in 1939. Obviously the President not only means business but he wants speedy action.

The President prefaces his recommendation with a brief review of his conception of the forest problem as it exists today in the United States. He points out that forests are intimately associated with our social and economic life; that “they grow on more than one-third of the land area of the continental United States”; that “wages from forest industries support five to six million people each year”; that “forests give us building materials and thousands of other things”; that forest lands “furnish food and shelter for much of our remaining game; and that “they furnish healthful recreation for millions of our people.”

Furthermore, he stresses the facts that “forests help prevent erosion”; that they “conserve water”; that “woodlands occupy more acreage than any other crop on American farms”; that they “help support two and one-half million farm families”; and that “the forest problem is essentially one of land use.”

With these basic facts, there can be no disagreement.

Next the President comes to grips with the question of privately owned forest land. He states that "privately owned forest land at present furnishes 96 per cent of all our forest products"; that "it represents 90 per cent of the productive capacity of our forest soils"; that "there is a continuing drain upon commercial forests in saw timber sizes far beyond the annual growth"; that "forest operations in them have not been, and are not now, conducive to maximum regrowth"; and that "an alarming proportion of our cut-over forest lands is tax delinquent."

The President recognizes that progress has been made in federal, state, and private forestry; but that the measures that have been taken are not adequate to meet the present situation. He asserts that our forest lands are still being exploited; that forest communities are still being crippled; that watersheds are still being denuded; that watersheds still suffer from erosion and floods; that our forest capital is still being liquidated; and, finally, that the forest budget still needs balancing.

Protagonists of private forest ownership may feel that the President has painted a somewhat misleading picture of the accomplishments and achievements of private forest ownership. If this picture actually is misleading, it is misleading not so much because of what was included in the background, but because of what was omitted. The President apparently painted the background with bold sweeping strokes; and he must have thought that all the fine details of private forestry accomplishments were neither necessary nor desirable in his picture.

His message is moderate in tone, accurate in important details, and signally free of denunciation, censure, and condemnation.

The President calls attention to the fact that the many technical agencies in the executive branches of the government dealing directly and indirectly with the forest problem will be available to the committee the Congress may appoint. It is sincerely hoped, however, that this committee also will avail itself of the experience gained by those engaged in the lumber industry because the industry can contribute much in formulating a workable program of public cooperation and regulation. If the program is leavened with this experience of those who will practice it, the chance for its success will be greatly enhanced.

In all sections of the country the President's message has been received favorably. As yet there have been no indications of any opposition on the part of the lumber industry. Moreover, there is every reason to believe that it will cooperate fully with this committee, if and where appointed. Not only will the committee have a great opportunity, but a grave responsibility. To it will be entrusted the responsibility of preparing a program to improve and to maintain the productive capacity of four-fifths of the forest land of the United States.

May the years to come confirm the President's belief in the ability of the American people to solve their forest problems after three centuries of experience. His message of March 14 may someday prove to be one of the most significant American forestry documents of all time.

THE ESSENTIALS OF A WILDLIFE RANGE¹

By RALPH T. KING

*Roosevelt Wildlife Forest Experiment Station
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The requirements of wild animals vary according to species, sex, and age; in addition the requirements of the animals included in each of these groups vary with the seasons and according to their physiological activities. The essentials of a wildlife range are those minimum requirements that must be available to each species inhabiting that range. Certain of these essentials are in the nature of materials required by animals to meet physiological demands; others are in the nature of pattern, that is, an arrangement of the materials that complies with their inherent limitations in the matter of cruising radii and saturation points.

WILDLIFE management consists almost entirely of environmental controls. Leopold has called attention to the two sets of factors which determine the presence or absence of wild animals in any region; these are: the breeding habits of the species, and the environments available to the species. Inasmuch as breeding habits are biologically fixed and cannot be changed by any known management measures this leaves us only the second set of factors, namely, the environment, through which we can by manipulation increase wild animal populations.

Manipulations of the environment are usually referred to as "environmental controls" and they may be either wholly artificial or wholly natural or any combination of artificial and natural procedures. Generally speaking artificial controls are justified only as emergency measures and should not be used with a view to continuing them over any long period of time.

In the development of any wildlife management program the importance of environment must be kept constantly in mind. Much of the investigational work of the program must be directed toward environmental studies and practically all of the management practices must deal

directly with the environment and thus only indirectly with the animal life.

If, for the sake of brevity, we conceive of a wildlife management program as consisting of five steps, namely: inventory, census, yield determination, diagnosis and control, it is not difficult to show that each of these steps must deal as much with environments as with the wildlife. In fact certain of the steps deal almost entirely with the environment and are concerned with the wildlife only indirectly. This is not to be interpreted as meaning that the wildlife is of secondary importance in the management program. On the contrary the primary aim of management is the maintenance of a satisfactory wildlife population, and we must always in final analysis reason from environment to wildlife. It is, however, essential that a proper and satisfactory environment be provided and maintained if an annual wildlife crop is to be produced.

Hasty analysis of the five fundamental steps of the management program will adequately illustrate the extent to which management must concern itself with environments.

First, the inventory determines what species of animals are present on the area in question and their distribution over the area. This, however, is only half of the

¹Paper No. 1 of the Scientific Journal Series of the Roosevelt Wildlife Forest Experiment Station, New York State College of Forestry.

inventory and is usually the less difficult half to accomplish. A complete inventory must determine in addition what species of food and cover plants occur on the area, their distribution, the distances separating them, their seasonal availability to the various animal species present, their accessibility to enemies, their exposure to the elements, and their trend as indicated by local cultural developments or natural succession or both.

Second, censusing is conducted in order to ascertain how much wildlife is present on the area. Unfortunately we usually think of censusing as having to do only with the wildlife of an area, this, however, is not true, or, at least, should not be true. It is equally important that we know how much habitable and productive, actual and potential, wildlife environment occurs on the area. It is not sufficient in this connection to measure the acreages of the various food and cover-producing species. The measurements must be carried to the point where they indicate not only acreages but show also the extent of interspersions of the various types, the degree of juxtaposition existing between the types, and the amount and distribution of the peripheral types present. The existence of cruising radii and saturation points makes interspersions and juxtaposition the two most important considerations in any wildlife environment where there is present any food and cover at all. These ideas were first clearly expressed by Leopold (2) in 1931.

Third, yield determination as applied to the wildlife of an area measures the annual productivity; as applied to the environment, it is concerned with the quality, condition and availability of the various cover types; and the palatability, availability, dependability, yield, persistence, and location with reference to cover of the various food species. Yield determination, as far as the environment is concerned, is not simply a measure of

the number of acres of the various food and cover species. It is, instead, a determination of the amount of habitable cover and available foods and an evaluation of the annual productivity of this combined food and cover. It is often the case that a measure of the annual increment of the wildlife on an area affords a means of determining environmental productivity, but this is an indirect method and frequently very difficult to accomplish. Furthermore, it is always necessary to make a complete yield determination of an environment before any proper diagnosis can be made. It is, therefore, only sound logic to complete the yield determination before attempting either diagnosis or control.

Fourth, diagnosis has almost entirely to do with the environment. After completion of the inventory, censusing and yield determination one must conclude either that the wildlife populations are all that they should be or that they are something other than they should be. If they are something other than they should be the explanation must be sought in the environment. The three steps in diagnosis are: (1) recognition of the factors operating against the various species, (2) evaluation of the effects of these factors, and (3) choosing the limiting factor. It is obvious that the first step is almost entirely concerned with the environment for the factors operating against the various species are in nearly every instance environmental factors. Evaluation of the effects of these individual environmental factors is usually a matter of further censusing unless accurate life equation tables for the species in question on the area under consideration are already available (this is rarely the case in our present state of management knowledge). To successfully choose the limiting factor necessitates not only a thorough knowledge of each of the environmental factors and a keen appreciation of their relative values

but involves in addition a clear understanding of the past history of the environments, their present trend, and their future probabilities.

Fifth, control measures are indicated by the results of the diagnosis and consist for the most part of modifications of the environment. Here again a thorough knowledge of the environment is of primary importance. Environmental manipulations are the basis of all control. In only exceptional cases are control measures applied directly to animal populations and in those rare instances when this does occur it is simply a preliminary step to environmental control.

Every environment is made up of a multiplicity of factors. Fortunately the wildlife manager need not be concerned about many of them. Those that he is concerned with can be separated into two groups: first, the essentials, those things that must be present or provided on every range if it is to support any wildlife at all and second, the extraneities, those things that occur on practically every range and must perforce be recognized in the management program although they are not essential to the productivity of the range. These latter are often the most obvious of all the factors operating on the range and frequently the most important but they are never essential to the success of the range and are usually highly detrimental to its productivity; they are ordinarily decimating factors such as poaching, predation, disease and parasitism. The range essentials include such obviously necessary items as foods, coverts, and water. This distinction between the two groups of factors is made in order that no one can be accused of saying that only the essentials are important in a management program. That is not the case, the others are also important and must always be included in the program but it cannot be denied that their absence from the range would in no wise reduce its productivity.

The essentials of a wildlife range may

then be listed as follows: foods, coverts, water resources, juxtaposition, and interspersion. The first three of these are materials, the last two are more in the nature of pattern. Every range must provide each of these materials in sufficient quantity and proper arrangement if it is to attain or even approach its highest state of productivity.

It is thus seen that a wildlife range—in so far as non-migratory species are concerned—is a communal home, or rather, a communal home territory, the size of which is determined by the cruising radius of the species; and this home territory must contain all of the species' requirements—foods, coverts, and water, for both sexes and all age classes, for all seasons and for all the species' activities.

If one were to ask, "What constitutes a wild animal's home?" Most persons, even those familiar with wildlife in the field, would reply, "A nest in the case of birds; a den or burrow in the case of most mammals." This answer, however, is far from being a true answer. These structures—nests, dens, and burrows—are usually only briefly existing parts of wild animals' homes. They are simply nurseries maintained and occupied for only a short period of the year while certain phases of reproduction are accomplished. Birds use their nests only while the eggs are being laid, incubated and hatched, and for a longer or shorter period after hatching until the young are able to follow the parent or parents; the length of this period depending upon the altricial or precocial properties of the species. In most cases there is no return to the nest once the young have left it; it has served its purpose as a nursery and is then no longer a part of the home. Dens and burrows are used by many mammals only during the period of parturition and for a short time thereafter until the young have gained sufficient strength to follow the mother. Usually there is no return to these dens or burrows once the young have begun hunting on

their own, and in the case of some mammals there is nothing resembling either a den or burrow established.

These nurseries are of course an essential part of every wildlife environment, and any environment must provide satisfactory nursery sites if it is to remain productive, for regardless of how nearly optimum the conditions for individual existence no environment will remain occupied for long unless there is proper provision for species continuance. The point is, however, that the nursery is only a part, a very important part it is true, but nevertheless a very transitory part of the wild animal home. Like the nursery in man's domicile, it is temporarily most important and apparently if not actually the center of all activity, but it does not constitute the entire home and would fail completely in its purpose if it were divorced from the other parts of the home. The kitchen, the pantry, the living room, and the bedrooms are all necessary adjuncts and quite essential to a successfully productive home. These adjuncts are, in the case of wild animal homes, usually referred to as food and cover patches. The food patches constitute the kitchens, pantries, and dining rooms, while the cover patches function as living, recreational, and sleeping quarters, as nurseries and quite often also as transportation and communication routes.

But here again in connection with food and cover we have been too prone to remain satisfied with only a very superficial understanding. Every one is willing to grant the need for food and cover in wildlife economy but there has been little attempt to understand the physiological, sociological, and perhaps even psychological relations involved. It would perhaps be readily granted that the different species have different needs in these respects but isn't it probably equally true that the two sexes in any one species have different needs? It has been clearly shown in the case of some species that the cover requirements of the female during

the reproductive period are vastly different from those of the male (white-tail deer for example); and it is equally well known that in some species the cover requirements of the male during the mating season are different from those of the female (for example, the drumming territory of the male ruffed grouse and the crowing ground of the cock pheasant). So also are the cover requirements different at different seasons. Winter cover is quite unlike summer cover; nesting cover may not be good feeding cover and very often is not satisfactory brooding cover; and mating cover in the case of some species is of no value at all for nesting, feeding or brooding. Cover requirements differ for the different age classes also; what suffices for adults may be and quite often is very unsatisfactory for the young.

The same marked species, seasonal, sexual, and age class differences are true in the case of foods. The differing food needs of different species are fairly well known although it is doubtful if we fully appreciate the true extent of these differences. It is also fairly well known that most wild animals eat different foods at different seasons and it has been assumed that this is due entirely to seasonal availability. It is doubtful if this is the complete explanation. It is, of course, true that they cannot obtain that which is unobtainable but it does not necessarily follow that they feed exclusively on those things that are easiest to get. In general wild animals make most use of those foods that occur in greatest quantity at a given time and place but there still remains, however, a fairly clear distinction between staple, preferred and emergency foods. It is not entirely unthinkable that certain foods are eaten at certain seasons because there is a particular need for them at that time and not simply because they occur at that time.

It is even more reasonable to suppose that there are different nutritional needs on the part of the different sexes. In the case of deer it is probably true that the

Stag utilizes as much energy in the production of a set of antlers as does the doe in developing a fawn but it is not likely that the same nutritional needs are experienced by both in process of accomplishing these two decidedly different ends. In the case of grouse it is possible that the males expend as much energy in the course of their mating antics as do the hens in the production of a clutch of eight to eighteen eggs, but it is doubtful if the same nutritive substances are required in both instances. Certainly it would not be surprising to find that there is some connection between the foods available to the female during the winter and early spring and the brood or litter produced later in the spring.

For example it is known that the chick developing within the egg draws on the mineral content of the egg shell for the mineral salts necessary for its skeletal development. These salts must be provided from the tissues of the mother during the formation of the egg and her only source of supply is in the foods available to her. Certainly her requirements in this respect are much different than those of the male who is not called upon to meet this particular demand. The same general principle applies to nursing females in the case of mammals. Both gestation and lactation give rise to food needs peculiar to the sex.

As for the food needs of the different age classes they are almost too obvious to require discussion. In no species are the very young able to subsist on the same foods that suffice for the adults. Wild animals are no more able in this respect than are domestic species. Ruffed grouse, for example, are, as adults almost exclusively herbivores, but their young are just as exclusively carnivores, more particularly, insectivores, and unless soft-bodied insects are available to them during the first few days of their life they cannot hope to survive.

It is thus seen that food and cover are something different and more complex

than they are ordinarily assumed to be. Each environment must contain all of the different types of cover and the various kinds of foods needed during the different seasons for the various activities of the several age classes of all the species it is intended that the environment should support. When all of these things needed by a single species are present in the environment they make of that environment a habitable range. If one of them is lacking it will seriously reduce if it does not totally destroy the productivity of the range.

This, however, is only a part of the picture. A block of wildlife range may contain in its various parts all of the types of cover and all of the desirable foods necessary for a species and yet support that species in only limited numbers or not at all. This fact, that extensive environments apparently containing every food and cover requirement are frequently totally devoid of certain species or support only very limited populations of these species has occasioned much discussion and has seemed to make diagnosis an uncertain if not an impossible procedure. The difficulty, however, lies in our failure to understand the biological limitations of the species with which we are dealing. The explanation is to be found in species' properties, two of which we have just recently come to appreciate, namely, saturation points and cruising radii.

It is perhaps only natural for us to assume that wild animals, simply because they are wild and unfettered and possess the ability to fly or run great distances should utilize these abilities to cruise over wide areas in search of their daily and seasonal needs. We have unconsciously held to that belief for a long time but now we know we were in error. Work conducted during the past few years has proven conclusively the existence of very definite cruising radii as demonstrable properties of the various species. According to Leopold (4) Stoddard's work on

bobwhite quail shows the average yearly radius to be not more than one-half mile for this species; Price with valley quail finds the average yearly radius to be one-fourth mile; Wight with ringneck pheasants finds one-half to one mile; Yeatter with Hungarian partridge believes three-fourths mile to be the yearly limit; Schmidt found one mile to be the limit in sharptail grouse, and my own work with ruffed grouse leads me to believe that the yearly average in this species will not exceed one-half mile.

It is thus seen that mobility varies greatly as between species but as Leopold (4) has said "it remains true that each species has a characteristic range of variation which differs from that of others, and which may accordingly be considered to be a property of that species." This new knowledge of cruising radii enables us to understand why certain wildlife ranges possessing all the necessary food and cover types may nevertheless support only sparse populations of wild animals.

Even though all of the required food and cover species are present in sufficient quantity they do not constitute a habitable range unless they are distributed in such a manner that every one of them occurs within the cruising radius of the animals requiring them, and unless they do so occur the range is valueless as far as those animals are concerned.

When all the food and cover requirements necessary for both sexes and all age classes of a species throughout the year are present on an area that does not exceed in size the cruising radius of the species then that area is a satisfactory communal home territory for that species. This distribution of all the species' requirements in relation to each other and in relation to the species' cruising radius is called *juxtaposition*. Proper juxtaposition simply means that *all of the species' requirements are so distributed in space as to cause them all to occur on an area that does not exceed in size the area encompassed in the species' cruising radius.*

Simple and obvious as this matter of juxtaposition may seem, it is nevertheless, one of the five most important properties of wildlife environments. The various kinds of foods, the different kinds of cover, and water constitute three of these properties; juxtaposition is a fourth and equally important property.

The fifth property of a productive wildlife range is also one that has just recently been recognized. It has to do with maximum populations attainable on any block of range. Here again our failure to understand the true state of affairs was due to our lack of knowledge of species' properties. In the past we have assumed that the number of individuals produced or maintained on any area was wholly dependent on the amount of food and cover present on that area. Acting on this assumption we have frequently attempted to increase wild animal populations on given areas by increasing the amount of food and cover present on these areas. Usually this has resulted in some increase in the amount of wildlife, especially has this been true in those instances where consciously or unconsciously an improvement in juxtaposition was accomplished. Most environments have been so modified that they have suffered not only the effects of poor juxtaposition but also from an actual lack of food and cover; as a consequence the wildlife populations they supported were far below the potentialities of the environment. Any improvement of such environments was bound to result in some increase in the wildlife.

It was only natural to assume that if slight improvements in food and cover brought about an observable increase in the amount of wildlife then more extensive improvements should result in still larger increases. Our reasoning was something like this: Even though it takes 800 acres of poor pasture to support ten cows we can by providing sufficient food and proper shelter support that same number of cows on one acre. In other words we

were acting on the principle that it was wholly a matter of *carrying capacity*. Carrying capacity is exclusively a property of the environment and it is true that the populations of most domestic species and some wild species are determined by this property. If sufficient food and proper shelter are provided along with some provision for sanitation enormous populations can be produced and maintained on relatively small areas.

There is, however, in most wild species another property inherent in the species that supersedes carrying capacity and determines the level to which populations may rise on any or all areas. This property Leopold (4) has called *saturation point*. It cannot be better described at present than simply as something within the species that determines and regulates the number of individuals of that species that shall occur on any area at any one time.

Any figure expressing saturation point must of course be an expression of the population density at some particular time of year. In practice the overwintering population, which is also the breeding population in the case of most species, is accepted as the population density to which saturation point figures shall apply. According to Leopold (3) in bobwhite quail this maximum population appears to be one bird per acre over large blocks of range and no amount of improvement in the way of increased food, better cover and reduced predation or hunting will cause them to exceed this figure. A recent paper on ruffed grouse (1) states that optimum grouse environments in Minnesota do not support more than one grouse per four acres. It is obvious that it does not require one acre to produce the food and cover necessary for one quail and neither does it require four acres to produce the food and cover necessary for one ruffed grouse. These maximum populations of quail and grouse in optimum environments are not determined by carrying capacity, they are in-

stead a measure of saturation point, a species property that regulates the height to which population levels may attain regardless of the excellence of the environment.

Knowing then that saturation point determines for many species the maximum populations possible on a wildlife range it is the business of good management to see that this maximum population level is attained or, at least, approached as closely as possible. He who attempts to surpass it is indeed foolish. Its attainment marks the successful rehabilitation of the range. All of the necessary food and cover species in proper juxtaposition will insure habitable and productive ranges, but one other requirement must be provided on every range if we are to build up and maintain maximum populations. This fifth range essential is practically perfect interspersion. Species' saturation points cannot be exceeded for the whole range, neither can they be exceeded for any part of the range except very temporarily. It is obvious, then, that each unit of the range as determined by the species' saturation point—one acre in the case of quail, four acres in the case of ruffed grouse—must produce its proportion of the total maximum population. There can be no permanent crowding of the animals into concentrations in excess of this saturation point; therefore, there can be no blanks in the sense of areas lacking in any single range essential if it is intended that the range shall maintain its maximum population.

This distribution of species' requirements in relation to saturation points is known as interspersion. Interspersion is the fifth of the five essentials of a wildlife range and may be defined as *the distribution over the entire range of all the food, water and cover requirements in a manner that renders it possible for each unit of the range, as determined by the species' saturation point, to produce its share of the total maximum population*.

The first four essentials mentioned—

foods, coverts, water, and juxtaposition—must be present on a range if it is to support wildlife in any quantity; the fifth, interspersation, determines to a large extent the size of the populations present. Maximum productivity can be attained only when all of the essentials are at optimum.

By way of summary the five range essentials may be stated as follows: (1) foods, (2) coverts, (3) water, (4) juxtaposition to fit the cruising radii of all ages of all the species at all seasons, and (5) interspersation such as will enable each species to attain its saturation point. The first three essentials must meet the re-

quirements for all the species concerned, for both sexes of all the species, for all age groups of all the species, for all seasons, and for all the species' activities.

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NO SUMMER WORK IN CCC FOR FORESTRY STUDENTS

DURING the summer vacations of 1934, 1935, and 1936, a certain number of students was authorized to be enrolled in the C.C.C. camps. During 1937 a different plan was followed whereby a somewhat smaller number of student assistants was employed at \$60 and \$70 per month.

It will not be possible to follow either of these plans this year on account of reduced budgets as well as a provision in the C.C.C. Act of June 28, 1937 which sets up a minimum period of six months for student enrollment. The strength of the Corps will be reduced to 1,200 camps by July 1, and in addition the total appropriation has been very materially reduced, all of which means that some drastic cuts are necessary in personnel, camps, and in projects.

According to the U. S. Forest Service, it will not be possible to make any special provision for the employment of forestry or other students in the C.C.C. camps assigned to the Department of Agriculture during the summer vacation of 1938.

LOBLOLLY PINE SEED DISPERSAL

By A. L. MacKINNEY¹ AND C. F. KORSTIAN²

During the fall and winter of 1936-37 fifty seed traps, set up in a Latin square design in and adjacent to a 70-year-old loblolly pine stand in the Duke Forest, Durham, N. C., were examined weekly. Loblolly pine seed fall started on October 14, 1936 and continued until the week of June 23, 1937. Maximum seed fall occurred during the week of November 18. Examination of the data indicated that dry windy periods contributed to a seed fall heavier than would otherwise be expected. The fall of seed was heaviest under the uncut stand and was lightest in traps on the leeward side of a clear cut strip, even though the row of traps was adjacent to an uncut stand. The viability of the trapped seeds was greatest early in the season and diminished as the season progressed. Position of the seed traps on the area studied apparently had little effect on viability of seeds trapped.

THE amount and periodicity of seed fall are important in the establishment of natural forest tree reproduction. The impression gained by many foresters in the Southeast has been that loblolly pine seed fall usually starts in late September or October, depending on seasonal weather conditions, and lasts for less than two months. In order to check this impression and to obtain data on the amount of seed fall an experiment was started in September 1936 in the Duke Forest at Durham, N. C., by the Appalachian Forest Experiment Station and the Duke Forest staff. The experiment was located in and near a clear-cut strip 132 feet wide and 800 feet long between two fully stocked stands of loblolly pine 70 years old. The experiment was set up in a 5 x 5 Latin square design. In each cell of the square two seed traps 3.3 feet square were randomly placed. The locations of the traps are given in Figure 1. It should be noted that one row of cells is located in uncut timber and that the clear-cut strip ran nearly perpendicular to the prevailing wind direction.

Careful inspection of the traps was made until the first loblolly pine seed was discovered in any one. After this

seeds were collected each week from each trap separately until no more seeds were found for a period of six weeks.³ All of these seeds were subjected to cutting tests.

The first loblolly pine seed was found in the traps on October 14. The intensity of seed fall increased rapidly from this time until the week ending November 18, at which time a total of 1,272 seeds (approximately 4.8 pounds per acre) were collected from the traps. After this the intensity of fall diminished until January 6, then remained practically constant until the week ending February 3. A secondary peak of fall occurred in the week ending February 17 and from that time on fall diminished gradually until in the week ending June 23 the last seeds were collected. (See Fig. 2.)

Examination of the curve of seed fall presented in Figure 2 indicates that weather factors possibly affected the intensity of fall in any one week. Attempt was made to correlate the total evaporation from free water surface, and number of days with rain during the week, and the total period of rain-free days culminating in any week with the difference in seed fall between that week and the preceding one. The multiplicity of interactions of

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²Director, Duke Forest, Duke University, Durham, N. C.

³The weekly seed collections from the traps were made by Forest Assistant C. M. Henninger, Duke Forest.

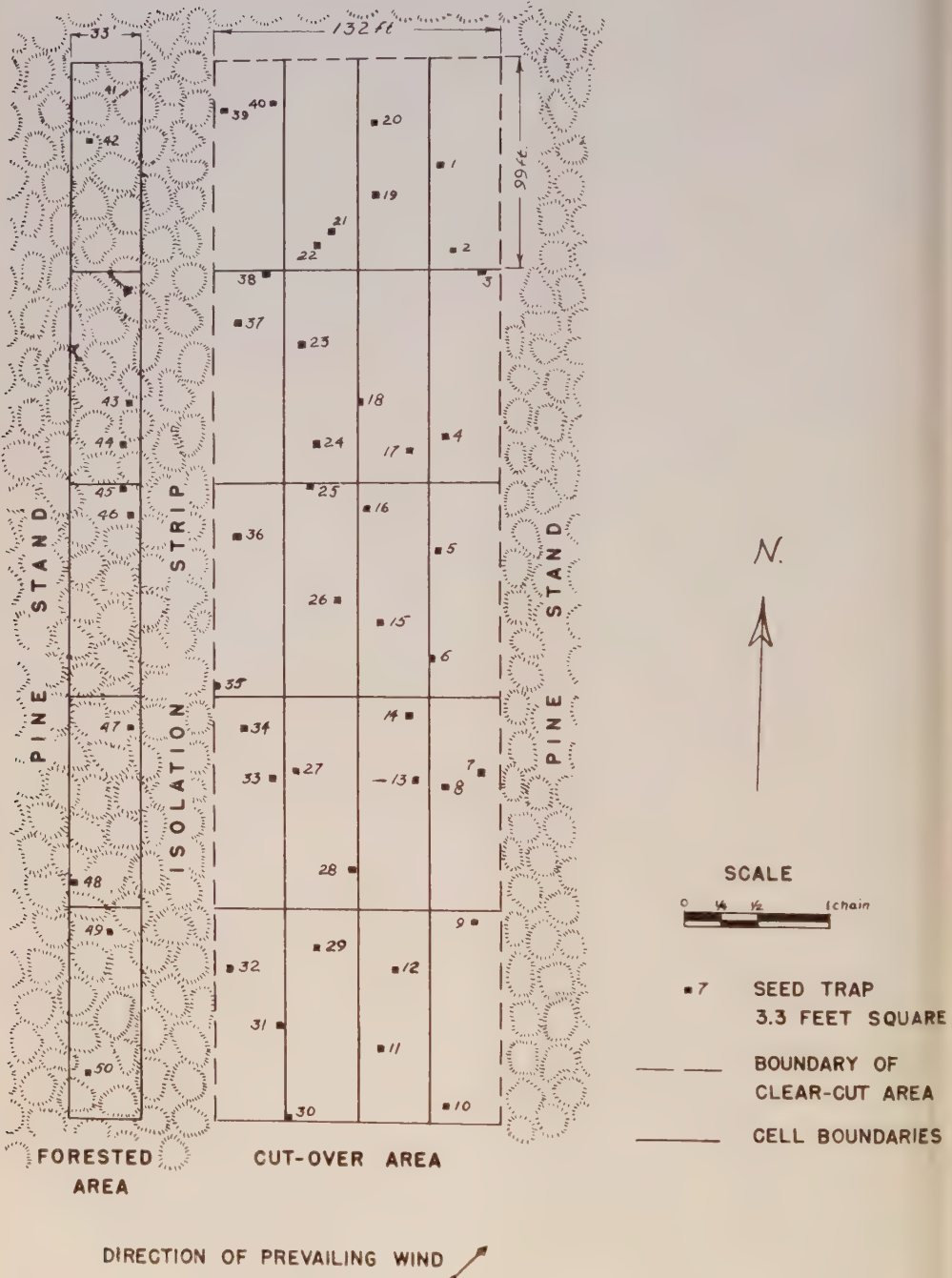


Fig. 1.—Design of loblolly pine seed trap experiment.

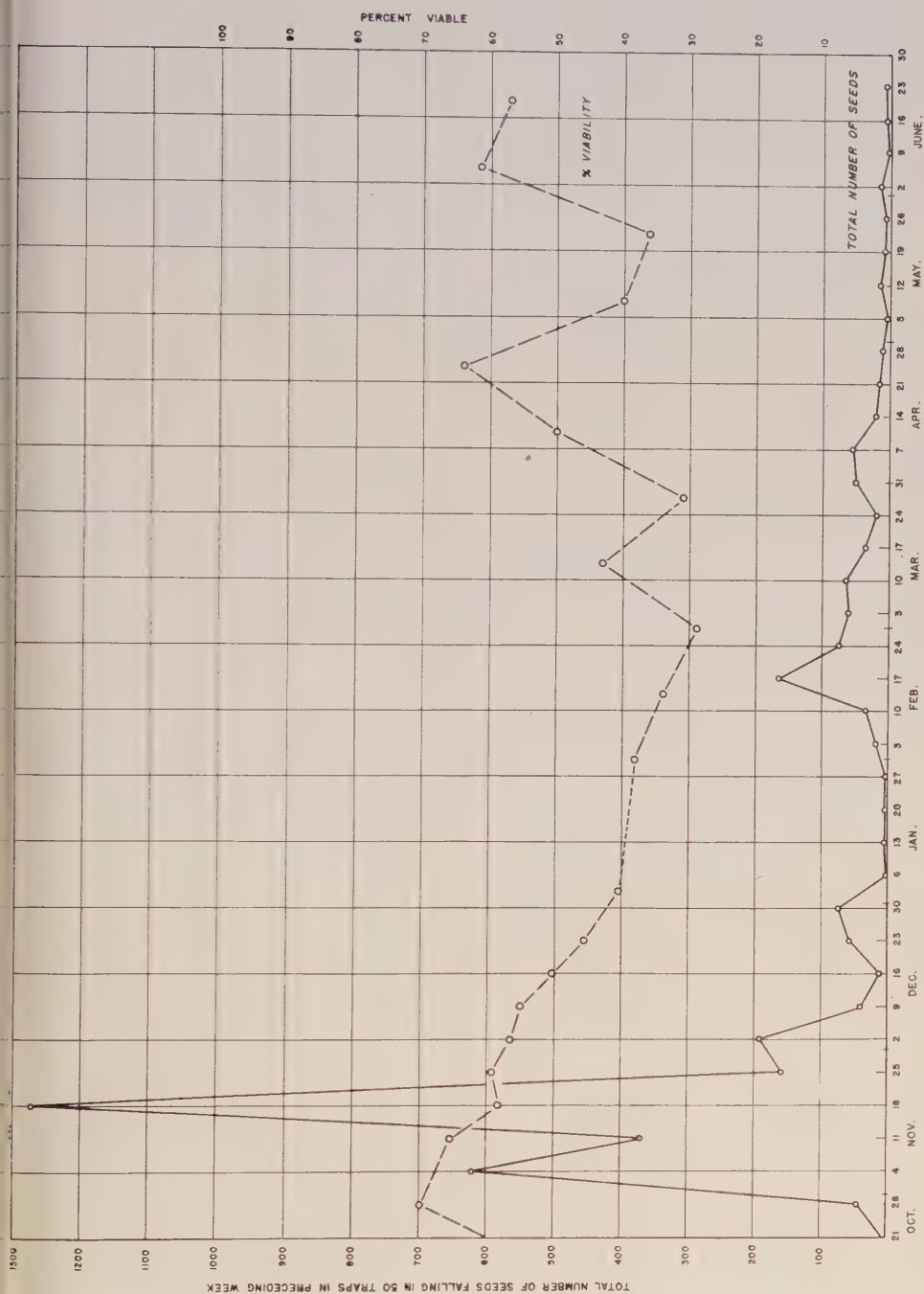


Fig. 2.—Total fall and viability of loblolly pine seed collected in 50 $\frac{1}{4}$ -mile traps during autumn and winter 1936-37. Seed fall per acre for any one week can be computed by multiplying individual plotted values by 80.

the various factors prevented a numerical evaluation of cause and effect. However examination of the data allowed an explanation of the primary vagaries in the seed fall curve. The seed fall during the week of November 25 probably dropped below expectation because the winds during the week were light and variable. The following two weeks with heavier seed fall were very similar in most respects except that total wind movement per week was nearly twice as much. The period of light seed fall between December 30 and January 27 was unusually wet, only 10 of the 28 days having no rain. In addition the evaporation during rain-free days was very low, indicating poor drying conditions. The secondary peak of fall reached during the week of February 17 can be attributed to relatively good drying conditions following the preceding rainy period, and culminating in two dry days with high wind velocities. The minor depression in the curve for the week of March 24 was apparently due to several wet humid days.

The percentage of the total number of seeds collected which contained fully developed embryos, as determined by cutting tests, was 56.6. The percentage was, as expected, higher during the period of heaviest fall in late October and November. It dropped from 70 during the second week to 30 sixteen weeks later. After February 24 the basis for the percentages was so meager that the ragged curve

means little. One important point is that after this date a total of approximately 10,000 viable seeds fell per acre. This indicates that reasonably satisfactory stands of reproduction may sometimes become established from seeds falling in the spring.

The total seed fall, estimated from the catch in the 50 traps was $281,120 \pm 5.9$ per cent per acre. This however, ranged from 431,200 per acre in the uncut stand through 256,400 per acre in the adjacent row, and 186,000 per acre in the next row, to 178,000 per acre in the row of traps on the leeward side of the strip. This difference is significant as is indicated in the analysis of variance table (Table 1), where the variation (mean square) due to row is 19 times as large as variation which could be attributed to row x column interaction.

Similar analysis was made for the effects of rows and columns on viability of the total seed fall. The results, presented in Table 2, show that there was no more difference in viability of seed in various rows and columns than could be expected from error of sampling. This indicates that under the conditions of this experiment distance and direction from seed source had no effect on viability of the seeds trapped. Separate analyses were made to determine whether the error of sampling both of total seed fall and viability varied with rows and columns. In both cases the error of sampling was not affected by either row or column.

TABLE 1
ANALYSIS OF THE VARIATION IN TOTAL SEASON'S
SEED FALL IN SEED TRAPS

Source of variation	Degrees of freedom	Sum of squares	Mean square
Row (parallel to edge of uncut timber).....	4	30,080.28	7,520.02
Column (perpendicular to edge of uncut tim- ber).....	4	2,555.48	638.87
Row \times column inter- action.....	16	6,375.52	398.47
Error of sampling.....	25	3,833.00	153.32
Total.....	49	42,844.08	874.37

TABLE 2
ANALYSIS OF THE VARIATION IN VIABILITY OF
TOTAL SEASON'S SEED FALL IN SEED TRAPS

Source of variation	Degrees of freedom	Sum of squares	Mean square
Row.....	4	236.38	59.10
Column.....	4	504.83	126.21
Row \times column inter- action.....	16	1,029.38	64.34
Error of sampling.....	25	1,087.37	43.50
Total.....	49	2,931.52	59.83

NATIONAL PARKS, NATIONAL FORESTS AND WILDERNESS AREAS

By H. H. CHAPMAN
Yale School of Forestry

The position taken by the Council on the proposed tunnel under the Rocky Mountain National Park has been questioned by some members of the Society. This fact is relatively unimportant because the issue involved is highly controversial. However, every member of the Society must be concerned with the procedures used by the Council to take a definite position on such a question. Professional societies are essentially democratic organizations and, as such, the administration of them must be democratic. In the following paper Professor H. H. Chapman, President of the Society, at the time the Council reversed the position previously taken by its Executive Secretary on the Rocky Mountain tunnel, describes in detail the procedure of the Council. This paper is published in order to give each member of the Society an opportunity to form his own opinion concerning the basis for and the justification of the Council action.

THE process of formulating public policies in democracies is neither orderly nor scientific. It sometimes reminds one of the rumblings and earthquakes preceding the occasional eruptions of a volcano. It would seem as if chance and whim played a great part in the resultant actions, yet we recognize that even seismic disturbances are due to measurable cause and effect. Any one eruption in public policy formulation is almost certainly brought about by the summation of the past forces and existing pressures bearing directly on the event and those who have not familiarized themselves with these historical and emotional factors are often surprised andaghast at the violence of the changes wrought in a few hours or by the stroke of a pen.

In a previous article¹ the writer endeavored to trace the growth of the movement for preservation by nonuse of park and wilderness areas in the United States, its clearly control and direction by foresters and scientists in the interest of a sane balanced land use economy, and its escape from this control, first in New York State and later through the historic accident which left the care of the National Parks

in the Department of the Interior, and which set up an offensive and defensive alliance between this basic idea of "preservation intact" and the administrative ambitions of a federal department.

Since the desire for this objective is founded not solely on reason or economics but on far more primitive and deep-seated emotions, and since man has demonstrated repeatedly in late years that reason has not yet succeeded in gaining the mastery over emotions, we need not be surprised either at the consequent eruption of "emotional" demands or the success or support which these measures frequently get in high places, or the ruthless disregard of how they affect the lives of humble and hard-working citizens. The lava flows on, and what a grand spectacle it is, and great for the tourist trade!

Still the case is not hopeless nor the forces irresistible. The point is that they cannot be ignored simply because they may be irrational. At present we have as one of these disturbances the struggle over the Reorganization bill now in an acute stage. This, as pointed out previously, is only superficially a departmental fight. Its roots spring from the

¹Chapman, H. H. Reorganization and the Forest Service. Jour. For. 35:427-434. 1937.

resurgent efforts to "stop devastation," restore the primitive and give us back our heritage of an unspoiled, undeveloped and (except for Indians) *uninhabitable* continent, a goal which is fundamentally sound and irresistible if kept *within reason and then only*.

As offshoots of this main war, two significant major campaigns have occurred and are still being waged. In one, namely the project for tunneling under the Rocky Mountain National Park, the forces of reason and balanced land use appear to have won. In the other, which is the creation of the Greater Olympic National Park, the tide is toward a sweeping victory for the emotional objectives.

In a letter to the Editor (JOURNAL 1938, p. 262) Robert Marshall, a director of the Wilderness Society, in a very courteous and restrained manner, takes the writer to task regarding his previous publications on the Society's attitude toward the tunnel, and the facts in the case. He admits that by the allocation of over 30 million dollars by the President for its construction, the tunnel will be built and the fight is "lost" or "won" depending on which side is taken.

In presenting his version of the facts and conceding defeat, Mr. Marshall's chief point is a challenge of the methods used in securing the backing of the Council in support of the tunnel project, specifically that no information was sought from those opposed to the tunnel, or a "hearing" given them by the Council before deciding. His proposal to provide an opportunity for different "factions" to present their arguments in writing to the Council, before decisions are reached on controversial subjects, is certainly worth careful consideration.

What was done in the Rocky Mountain case? Leaving out of consideration the action of such organizations as the American Forestry Association, the Wilderness Society, or the National Parks Association, or whether the boards of directors

of these associations permitted members thereof who were favorable to the tunnel an opportunity to be heard before condemning the project, we know that in the case of the Society, its former Secretary was persuaded during March 1936, to sign this protest without investigation of the facts, on the representation of these organizations and others, and that he did not then or later even inform the President or the Council of his action, until after it was independently discovered, in Denver, by the President three months later. This procedure would probably be conceded to be undemocratic, and the President's course from then on, covering a year's investigation, was intended to democratize the findings and action of the Society.

The arguments in opposition to the tunnel were all a matter of public record, having been reiterated in the *Wilderness News*, the National Parks Association bulletins, and the public press. The Council had access to all these statements. It was their job to check up on the statements with factual evidence. As soon as it appeared from this intensive study that the facts seemed to warrant the reversal of the Secretary's arbitrary attitude the respective secretaries of the Wilderness Society and National Parks Association were immediately notified, on April 26, 1937, through the following letter:

"In March 1936, our Secretary, Mr. Franklin Reed, committed the Society of American Foresters to the position of opposing the proposed water diversion tunnel under the Rocky Mountain National Park without informing the President or Council of his action, then or subsequently.

"The Central Rocky Mountain Section of the Society through its officers, and without taking a position on the subject protested that the matter should have been investigated by said Council before the position of the Society was taken. This correspondence in turn was with

held by Mr. Reed from the officers and Council.

"This action of the Executive Secretary was later justified by him on the ground that an emergency situation existed, and that the position taken was justified by the consistent policy of the Society in previous instances touching National Parks.

"I make this statement in order that you may understand why it was necessary for me to look thoroughly into the matter, which I have done.

"The Society is prepared to reiterate its position of hostility to commercial encroachment on the existing National Park System including any legitimate extensions thereto.

"There are certain facts however regarding the proposed tunnel which seem to have been overlooked by its opponents, in their fear of establishing a precedent. These are:

"1. That when this National Park was created, there was passed by an act of Congress a provision that it should not thereafter prevent or obstruct the construction of ditches or tunnels for water. The needs of this region for additional supplies were early recognized. Disregard of this legislative enactment in my mind constitutes a distinct and unwarranted betrayal of the large agricultural population in northeastern Colorado.

"2. That by the plans of the Bureau of Reclamation which I have studied, the tunnel will nowhere appear within the boundaries of the Park. These plans have been altered with this distinct purpose. Since the entire objective of your associations is to prevent commercial desecration of park surface this objective is not in any way violated by this proposed tunnel construction. Furthermore, the dumps at either end though outside the park are to be landscaped so that they will not be noticed, as a concession to park sentiment. I must add, that the enormous cuts and fills of the new road

over the divide are a real and permanent scar to which no objection has been urged as far as I know.

"3. That in the face of these facts, the argument of a precedent for commercial exploitation, used to prevent the accession of water without which existing irrigated lands cannot produce more than about half capacity appears to me to fall of its own weight, *unless*, on the basis of purely emotional theory, the existence of a subterranean passage so offends the defenders of park sanctity that half of the population in the densest portion of Colorado's agricultural lands must be condemned to starvation or become public charges in order that the park visitors can be assured that the only water buried in the mountains is there solely by natural means and not by act of man.

"4. That the suggestion of carrying this water around the park is wholly impractical as the lands that could so be reached are not adapted to the purpose, and those that need it could not be reached, thus leaving them in the same condition as now.

"I shall not cite figures on cost and benefits since there may readily be obtained from the official reports of the Bureau of Reclamation, U. S. Department of the Interior, which department administers the National Parks.

"This investigation has been conducted with an open mind and in the light of the definite stand which the Society has taken on other commercial projects within National Parks.

"It may be added that definite plans and continuous local agitations exist for a large southern extension of this Rocky Mountain National Park, on the part of the officials of the National Park Service, which would of course carry the same prohibitory assumptions as to water diversion."

No acknowledgment or reply was ever received from either of these organizations then or since. Consequently, the Council

was asked to give its approval to the position taken, by ballot, which it did. Mr. Marshall was notified by the Secretary of the Wilderness Society promptly, but confined his activity at that time to a demand to know by what authority the president had taken the position indicated. Meanwhile, the president, in view of further published statements regarding the feasibility of an alternate route, informed the Council that he would withhold any published commitment of the Society until further thorough investigation, which was carried out in person during June 1937, in Colorado while the tunnel bill was up in Congress. Directly after his return the press in Colorado carried misleading statements attributing to the Society testimony given by the representative of the American Forestry Association opposing the tunnel. The position of the Society, as approved by the Council was then released, on June 13th. During this period no one had offered to present to the Council any elaboration or proof of statements opposing the tunnel, despite the advance notice given and abundant time allowed.

Had the factual investigation of these statements developed any evidence substantiating the opposition, this evidence would have been presented to the Council—it was for this purpose, and not to bolster a position taken, that the case was studied for over a year.

The Wilderness Society representative rightly claims that the protests resulted in modifications of the original plans by which the park surface is to be left unscathed. But the opposition continued unabated despite these changes, although the new plans were publicized and were the basis for the Society's action.

This bill sought, and secured, specific authorization from Congress for the project, as required by the act of March 3, 1921, in an effort to deal in good faith with the people of Colorado who had withdrawn their opposition to the Nation-

al Park only after being assured by the clause in the enabling act that they would not be deprived of this water, need of which was anticipated, by the creation of said park.

Data on the validity of the assumptions or promises that no shafts or roads to shafts will be constructed within the park rests on the positive statements of the reclamation engineers at Denver. The depth of the tunnel below the surface, of some 4,000 feet, was said to preclude shafts as an economic method. The point most emphasized is the possible draining of lakes (which would be equally true of any alternate route to the south). Here again, the evidence is that one small lake was temporarily lowered in constructing the Moffat tunnel (whose depth below the lake has now been ascertained, as about 1,100 feet) but was restored by silting in of the leak. The reclamation engineers stated to me that they foresaw no possibility of any drainage but that if it occurred it could and would be stopped. The tunnel incidentally must and will be lined with cement. Very positive evidence was given, and included in reports of the Reclamation Service showing that the net cost of water to the users was well within their capacity to pay and lower than from similar projects, running \$2 per acre foot on a 40-year payment basis, for \$24,800,000, with power development costing, and taking care of an additional \$19,083,243. The predicted losses in agriculture are based on actual losses for 10 years, and are similar to any other predictions for the construction of irrigation works and again are based on engineering estimates. All these facts were supplied to the Council and were available to others over a long period.

The question resolves itself into that of proper procedure. Apparently the rules of evidence and procedure acceptable to the Wilderness Society directors, who have the power to expel any mem-

ber not in sympathy with the objectives of the Society, are not acceptable to these same persons as members of a professional society. This is as it should be. But has there been any violation of proper "democratic" procedure by officers and Council, in this case, when every contention and argument against the tunnel was subjected to exhaustive factual test, which can be discredited only on the basis that professional engineers were in this case capable of "coloring" the facts to suit the objectives? Had the opponents taken advantage of the opportunity to present arguments to the Council, exactly the same procedure would have been followed. In this case the Council held that on the basis of the evidence its responsibility was to decide what to do in the case of a specific piece of legislation, fully considering its import on the general principles involved as well as its local significance. *It is hardly possible to make such specific cases the subject of referenda to the membership.*

If on the other hand, a policy of inaction was desired of the Council as a substitute for support of, or opposition to the tunnel, in other words, the tying of the Council's hands, those who favor the extension of National Parks and wilderness areas can consider the situation in regard to the Olympic National Park as more to their liking. This movement has focused all the forces in favor of more and larger National Parks on the securing of the largest possible extension of the Olympic National Monument as a new National Park. My efforts to present this matter to the Council extended over a period of about two years. I made no recommendations for specific action, either for or against the park or as to its boundaries. These were the subject of constant debate by all concerned, with various suggested modifications. It early became my opinion that the drive for the national park would ultimately succeed by weight of pressure exercised on a national scale

and cropping up in articles and editorials with the usual strong emotional appeals. No personal investigation by the Council was possible, and the conflicting evidence was so great that the Council never felt in a position to pass judgment on this measure or take a stand on any of the bills presented. Perhaps they should have done so, and with the same kind of an exhaustive report as was available on the tunnel controversy they might have announced a stand. But the factors in dispute were, first, whether there should be a park or a wilderness area, and second, how much timber should be "sterilized" or "preserved" to satisfy legitimate needs of the public.

Having been unable to make any progress with the Council for the reasons stated, the president attempted a more basic project, namely, the clarification of principles with regard to parks, forests, and wilderness areas, by the democratic process of a referendum. The first draft of this referendum, resulting from three revisions by the old Council, was finally published in the December S. A. F. AFFAIRS, 1937, page 179, and the final completion of the referendum, after allowing ample time for discussion by the membership, is left to the new Council. By the time this process is completed, the Society will at least have established certain planks for the guidance of future Councils, though the Olympic question bids fair to be settled long before, and in favor of a greatly enlarged park taking in most of the commercial timber nationally owned on the peninsula, with the utter disregard of the possibilities of a rational plan for land use or consideration for any but the desires of the "new" conservationists. This statement is based on the most recent information, the source of which, according to precedent and custom, must remain "unquoted."

If and when this great area is "saved" for the public, the next dispute, which is already under way, will be between the

wilderness advocates and the park administration. The latter if it follows precedent, will open up this wilderness to the public by roads and install hotels and other accommodations. But pressure is strong to hold it, not as a typical developed national park, but as a true wilderness, dedicated to "youth," and accessible only by trail, on foot or pack horse, with over-night shelters of course, and other aids to pedestrians or caravans.

Meanwhile a terrific drive is on by the National Park Service, to capture and capitalize the sentiment back of the wilderness idea, and with this backing to secure as parks, the 11 million acres of wilderness or "primitive" areas already established within the National Forests, as well as further great extensions, to an approximate total of 35 million acres, practically all of which must come from the National Forests. One of the most pressing arguments used is the assumed precarious status of any area set aside for a wilderness solely by executive orders of the Forester or Secretary of Agriculture. For this reason I felt that wilderness

areas should be given legal status by acts of congress, but that on the other hand they should remain as integral portions of the National Forests and not be transferred and take park status, to be subjected to the pressure for development which is desecrating so many of our most prized National Parks like the Yellowstone and Sequoia.

This statement is my contribution to democratic procedure, in furthering discussions of this proposed referendum. Some day the Council may thus secure for the members a platform on which to act in the case of the numerous future bills and drives for park extensions and annexations, including the Kings River Canyon of the Sequoia, which is again reaching the boiling point, and the southward elongation of the Rocky Mountain National Park to take in the territory under which the "alternate" tunnel route was proposed.

This will be a good opportunity for wilderness sponsors to state their position in advance of any such actions by the Council, and for its guidance.



A. A. ALLEN ELECTED PRESIDENT OF THE WILDLIFE SOCIETY

THE Annual Meeting of the Wildlife Society was held at Baltimore, Md., on February 14, 1938. The following officers were elected: A. A. Allen, President; F. H. Langlois, Vice President; V. H. Cahalane, Secretary; Warren W. Chase, Treasurer.

W. L. McAtee was reappointed Editor of the *Journal of Wildlife Management*. W. L. Finley was elected a Trustee and E. B. Komarek and James Moffit were elected to the Membership Committee.

The Society passed a resolution calling upon authorities concerned to investigate and put into effect methods of control of the wilt (*Cephalosporium* sp.) which seemingly threatens the existence of the native American persimmon, an important wildlife food found in the southeastern United States.

RESPONSIBILITY FOR PUBLIC ATTITUDE TOWARD PRIVATE FORESTRY¹

By EMANUEL FRITZ²

The author is severely critical of the U. S. Forest Service. He believes that it suffers from a superiority complex which reacts against the best interests of "dirt" forestry, subjects foresters and forestry to ridicule and gives the private owner some cause for suspecting the real motives of the bureau. He writes: "There is no desire to break down the Forest Service, rather it is sought to break down the obvious smug self satisfaction and replace it with a constructive helpfulness."

WRITING this paper has given me no pleasure at all, and I do not even like to read it before an audience or see it, later, in print. Frankly, I am going to be critical not only of the federal Forest Service but also of those foresters who obtain their cues from the Service and have no will of their own nor the ability to see forestry from its practical sides. I have many friends in the Forest Service and have a wholesome respect for its field force. Some of these men seem utterly discouraged in their work. Sometimes they seem to be confused over all the non-essential and non-productive work piled upon them. Yet they are often the very men who know most about forestry problems and how they might be solved. They can not understand, and neither can I, why their superiors in distant offices create such a rumpus over a diverse and often unrelated lot of forestry matters without taking the trouble to get far out of their offices. My comments are not directed to field men, but to those of their superiors who establish or direct policies and like to get into the papers as guardians of the public's welfare.

I am an alumnus of the Forest Service myself, but, like the college alumnus, I think I have the right to be critical of this "Alma Mater" when I feel she is overstepping the bounds of good common horse sense and is laying barriers in the paths of forestry progress.

From the first days of American for-

estry, the public approach to private forestry has been determined by the Forest Service and its volunteer spokesmen. This approach took the form of a vigorous program of vilification of the lumber industry—not before lumbermen, but before the public. Looking back, it seems to me that our forestry leaders chose deliberately to incite public wrath against the industry, thus to discredit it and make foresters appear as saviours. There seems to have been little, if any, real effort to analyze the causes that led to what was called, and rightly called, forest destruction. It was apparently a political expedient. The same kind of politics is being played with forestry today. As a result, private forestry has not prospered as it should. Our forestry leaders, themselves, have thwarted attaining the very desirable ends they sought to achieve. We do now have a good start toward private forestry. In every forest region, interest is increasing and substantial progress is being made. Nevertheless, it is still forestry-political expedience to ignore or belittle such improvement and we still have the program of discrediting the industry going on.

I wish it were possible to say that what progress has been made can be credited to those who cried loudest. But it is not. I can draw only one conclusion from this, and it was strengthened by happenings during and immediately after the N.R.A. days; it is this—there is an important group of foresters, both in and out of

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public service, which *does not want private forestry to succeed*. Its attitude is anti-industry and it sees nothing but public ownership or public control as satisfying its will. Some of this group have been to Europe and returned with glowing stories of the success of private forestry abroad, but they can not, or will not admit that private forestry has any place at all in this country.

Let us examine some contrasts. A German forester, for example, is not only a tree grower, but a keen utilizationist. His silviculture is predicated on what it will return. Economic conditions permit him to practice more and better silviculture than will be possible in this country for several generations. In America, most foresters would like to be known as silviculturists, and they act as though some stigma were attached to the word lumbering. American foresters are not foresters at all in the European sense—they are aestheticists.

For another example, let's look at agriculture. As far back as the Civil War period, important laws were passed to *aid and improve* agriculture, and there have been some very significant laws passed since. Somebody had the vision to see the importance of agriculture, and that it can be improved but he had the good sense to know, also, that the story must be taken direct to the farmer. Furthermore, the lawmakers made provision for finding out just what could be done. One of the earliest problems was "How can we approach the farmer?" No one went up and down the country vilifying the farmer as a public enemy because he practised a wasteful form of agriculture. A condition was acknowledged and steps were taken to remedy it. In forestry, on the other hand, the lumber industry was pretty much left out of the picture, somewhat as a malicious incorrigible person who deserved no consideration and could be dealt with only by force. It gave the speakers the public notice they loved. It's a lot easier and takes less courage to con-

demn to the public some malpractice of an industry than to work out practicable remedial measures and present them to the industry itself.

Agriculture is the country's outstanding example of government trying to be of *help* to an industry. Of recent years this has been taken to extremes, and in no uncertain way has put the farmer on the government pay roll. That part is bad, but let's overlook that for the real good the Department of Agriculture has done.

It is claimed that forestry is a cropping of trees and, therefore, a branch of agriculture. It is one reason given for resisting a transfer of the Forest Service from the Department of Agriculture. Well, forests should be handled as a crop wherever it is practicable, but it seems rather inconsistent for a federal department through one bureau to be helping the agricultural crop farmer, and through another kicking the forest crop farmer in the pants and clear down the steps. If forests should be handled as crops, then the Department of Agriculture should give their owners the same consideration it gives to agriculturists. It will be argued that help is being given the forest owner. It has; through the Forest Products Laboratory, and, in some other ways, but all this help is largely nullified by other groups keeping up an incessant sniping. I used to think, myself, that the industry deserved all the opprobrium directed its way. I certainly do not hold it blameless today. But, long ago, (and my present connections have had nothing to do with establishing these views) in trying to find ways and means to apply forestry to private lands, I tried to single out some of the problems that acted as barriers. I found plenty. Some, I believe, can be solved if we apply the approach used in getting the farmer to practice better agriculture. Others, and they are very important, will have to wait until economic conditions make it feasible to correct them.

Lumbering has been of a destructive

kind in the past. In many respects it is still so, and it is going to continue to be so until conditions make different management feasible, or we find feasible methods for improving it. It is not entirely free from being destructive even on National Forest timber sales. Even farming is destructive, and I venture the guess that farming has been far more destructive of land values in one century than lumbering has been in three. Yet no group has set itself up before the public self-righteously calling the farmer names for it, nor as having all the knowledge necessary for its correction. I think you'll find lumbermen quite willing to acknowledge that logging has been destructive; at the same time, they resent the imputation that they have been destructive through wilfulness and greed.

I expect my criticism to be considered unfair. Any forester who has even the thinnest connection with private industry is held under suspicion by his colleagues in public employ. If he is critical, he is branded as being hostile to the government service. There are foresters in this room—men of unquestioned integrity—of whom it has been said, "They have gone over to the enemy." That just about epitomizes forestry sentiment toward the most essential industry in any good forestry scheme. It isn't as bad as it used to be, but it still exists. It has caused forestry to be subjected to ridicule and it has made it extremely difficult for a private forester to make the progress that he otherwise should make.

Those of us who are concerned with the practice of private forestry have a difficult job. We have to overcome some of the opposition that our colleagues have created; we must acquaint ourselves with the problems of timber ownership and operation; we must determine how much forestry is feasible and how much, if anything, it will cost, and how it can be instituted. Above all, we must develop confidence in our good sense and our

technical ability. In my own case, I feel I can afford for the present to forget that such a thing as forestry exists, because some of the more important first essentials can be shown to be good business. I am happy to say that, in the redwoods, very substantial progress is being made in adopting some of them. Once a start is made, the rest is less difficult.

To sum up what I think our public forestry leaders might do to help along private forestry, I offer the following:

1. Acknowledge with generous praise that substantial progress is being made in private forestry.

2. Quit nagging the lumber industry and quit being alarmists.

3. Study with an open mind the problems connected with the owning and operating of timber.

4. Never forget that any industry must get its funds through its own efforts and that it has no outside treasury to draw upon.

5. Shun self-righteousness, impatience, arrogance, and intolerance.

6. Prove their sincerity by a more aggressive fight in Washington for the passage of laws that will make it possible for you to make good on your past promises.

7. Subordinate bureau interest to that of forestry in the woods.

8. Before rushing into print or to the microphone with a story of how poorly private lands are being managed, take it up with the owners concerned.

9. Quit striving for an ideal forestry picture unless they are willing to do some of the unpleasant work on the units of that picture first.

10. Try to get over the old superiority complex.

11. They should not try to do everything at once. Be satisfied with wanting one thing as a time, but, before they demand anything, be sure they have met with others first and have gotten their viewpoints.

SOIL TEMPERATURES DURING FOREST FIRES IN THE LONGLEAF PINE REGION

By FRANK HEYWARD
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The effect of heat on soil is a subject which has received much study. Many important changes in fertility have been found to be associated with heating of soil. In the following paper, which is part of a comprehensive study of the effect of fire on soils in the longleaf pine region, data on a number of soil temperatures recorded in the field during fires are presented.

THE longleaf pine region is described in detail elsewhere (3, 4). Because of the open stands of timber and lack of underbrush,¹ forest fires in this region are largely of the surface type; but owing to the exceptionally heavy rough² (Figs. 1, 2, 3, and 4) on areas protected from fire for several years, surface fires may generate much heat, as evidenced by severe scorching of trees 50 to 60 feet high.

Forest fires are more common in the longleaf pine region than in any other portion of the United States. Indeed, until recent years, the ground cover and undergrowth of practically the entire area comprising the longleaf pine type was burned at least once every 2 or 3 years. At the present time, however, numerous large forest areas, comprising thousands of acres, are being afforded complete fire protection.

One of the distinguishing characteristics of the longleaf pine type is that forest fires occurring in this type do not generally create the conditions of waste and desolation typical of forest fires in other timber types of the country. This is due both to the fact that most fires are surface fires and also to the fire resistance of longleaf pine. Recognition of these conditions forms the basis of controlled burning, a practice recognized by many

silviculturists in the management of longleaf pine forests.

But whether fires are accidental or set for silvicultural purposes, they heat the soil to some extent. If the temperature attained is sufficiently high, destruction of soil organic matter and also damage to the soil biota would ensue, causing a depletion of soil fertility.

PURPOSE OF PRESENT STUDY

The object of the present study was to determine the maximum soil temperatures occurring during fires which burn through various types of fuel in longleaf pine forests, not including, however, catastrophic fires, such as those occurring during the dry year of 1932. No attempt was made to determine the complete range of soil temperatures for each fuel class; rather, fires were studied under medium to bad fire weather, and at all times temperatures were recorded under the heaviest accumulation of fuel. The temperatures given in this paper, therefore, may be considered as being close to the maximum temperatures for hot fires under a given fuel class.

FIELD PROCEDURE

Method of Recording Soil Temperatures.—Temperatures were recorded by means of a 3-pen antiambi thermograph of the revolving disc type or by thermo-

¹The absence of underbrush is attributed to recurrent fires during past years; areas protected from fire for several years frequently develop a dense underbrush of hardwoods.

²In the longleaf pine region the combination of ground cover and shrubs, both living and dead, is known as "rough." A "1-year rough" is one protected from fire for 1 year; likewise a "6-year rough" is one protected for 6 years.



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Fig. 1.—Grass rough typical of heavier textured longleaf pine soils. This type of rough occurs extensively throughout the middle and upper Coastal Plain from South Carolina to central Mississippi. [*Andropogon tener* (Nees) Kunth.] is one of the plants most commonly found in this particular rough, Pearl River Co., Miss.



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Fig. 2.—Detailed view of a heavy 6-year rough. This is the same type as that shown in Fig. 1. Escambia Co., Ala.

couples. The heat sensitive portion of the thermograph consisted of 3 metal bulbs, each $2\frac{1}{2}$ inches long and $\frac{3}{8}$ -inch in diameter.³ The bulbs were inserted at the desired soil depth, and the soil and fuel replaced as carefully as possible. Each of the three sensitive bulbs was connected to the recording mechanism by 25 feet of heat resistant, flexible metal cable. It was, therefore, possible to measure three different temperature trends simultaneously for any duration desired, each being recorded as a separate curve. A 15-minute clock was found to be ideal for this use. If, for any reason, it was desired to continue a record for more than 15 minutes, the chart was permitted to revolve twice (30 minutes) or even three times (45 minutes).

The thermograph was mounted on a tripod provided with a detachable case of plywood which completely enclosed the instrument and was large enough to provide a dead air space several inches thick. A sheet metal protector (essentially a large tin can), within which a large dead air space also existed, fitted completely over both tripod and instrument box and rested on the soil surface.

Preliminary Work.—Preliminary work was necessary to determine soil depth most desirable for placing the bulbs and also to determine an adequate size of plots for experimental fires. From the first tests it was apparent that, if records showing noticeable changes in soil temperature were to be made even during very hot fires, the sensitive bulbs of the



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Fig. 3.—Four-year rough typical of longleaf pine forests of the Georgia and Florida flatwoods. Saw palmetto [*Serenia serrulata* (Michx.) Hook.], wiregrass (*Aristida* sp.), and broomsedge (*Andropogon* sp.) are the principal species. Columbia Co., Fla.

³The thermograph was checked against a copper-constantan thermocouple made of number 28 wire. Based on a total of 18 test fires, a slight lag of a few seconds was indicated for the thermograph when installed at a soil depth of $\frac{1}{4}$ -inch. Although the thermocouple and thermograph bulb were only a few inches apart in the soil, considerable variation was recorded in maximum temperatures. Probably largely due to chance, the mean maximum temperatures for the 18 test fires were 158° F. for both thermograph and thermocouple.



Fig. 4-A.—Detailed view of a heavy, 5-year rough of wire-grass in the Florida flatwoods. This site is too moist for saw palmetto. The scale in the photograph is 12 inches long.

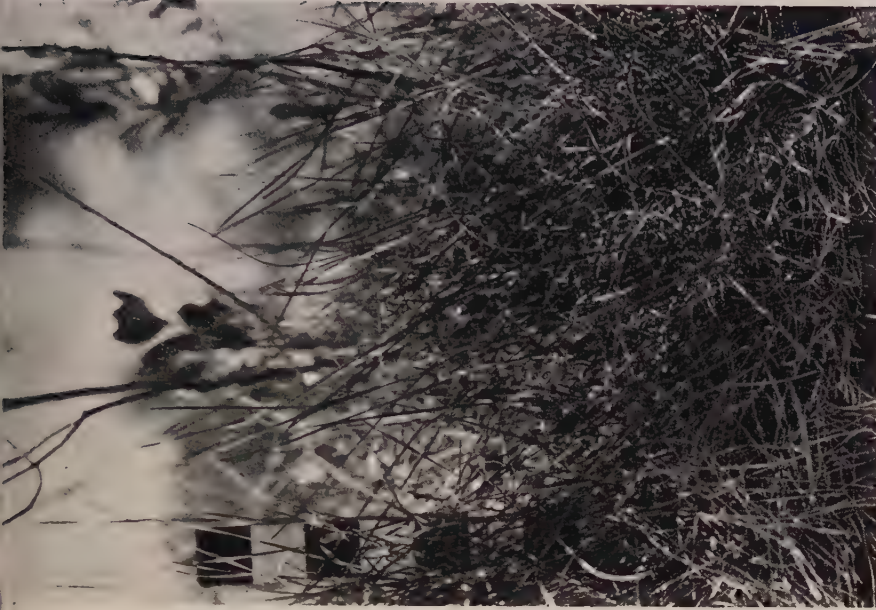


Fig. 4-B.—The dense but low ground cover [*Sporobolus curvisii* (Vasey) Small] found under gallberry [*Ilex glabra* (L.) A. Gray] on other moist sites in the flatwoods. Compare this 5-year rough with that illustrated in Fig. 4-A.

recording instruments should be placed at a depth of not more than $\frac{1}{4}$ -inch.

Further study, based on a 40-acre fire, revealed that fire area was of minor importance in influencing soil temperature. This is not surprising when it is remembered that the fires studied were surface fires and that the chief fuel was grass. Fires of this nature rarely create a great draft or build up a head as do crown fires. Soil temperatures, based on 21 individual records, were no higher for the fire which burned 40 acres than were temperatures recorded from plots 10 feet square having the same type of rough.

Final Work.—Soil temperatures were recorded for 44 fires burning over areas ranging from 100 square feet to $\frac{1}{4}$ -acre. These fires occurred at 5 locations within a 40-mile radius of the Olustee Experimental Forest, Olustee, Fla.—typical “pine flatwoods”—and on the Harrison Experimental Forest, in southern Mississippi. The flatwoods soils studied were fine sands of the Blanton, Plummer, and Leon series, and were characterized by medium to poor drainage. The study in Mississippi was confined to Norfolk fine sandy loam, one of the most prevalent soil types in the longleaf pine region. In most cases continuous records of temperature trends were obtained for the $\frac{1}{8}$ - to $\frac{1}{4}$ -inch soil depths long enough to show the maximum temperature attained during each fire.

During a number of fires the maximum temperature attained at a depth of $\frac{1}{2}$ -inch was recorded by glass maximum thermometers placed under the sensitive bulbs of the thermograph. Soil temperatures were recorded under the densest portions of all fuel types studied, the thermometers being located under, and not in the openings between, clumps of vegetation.

Fires burning both with and against the wind were studied. These occurred in several fuel types, which included the chief natural fuel combinations encountered in longleaf pine forests. These types are described in Table 1.

RESULTS AND DISCUSSION

The soil temperatures recorded for the $\frac{1}{8}$ - to $\frac{1}{4}$ -inch depth for the flatwoods areas are graphically shown in Figure 5, in which temperature ($^{\circ}$ F.) is plotted over time interval (minutes). To facilitate comparison, all curves have been reduced to the same starting time. A slight lag (usually less than half a minute) in temperature rise after passage of the fire over the thermometers is not shown by the curves.

Effect of Identity and Quantity of Fuel on Soil Temperature during Fires.—Figure 5-A shows that a maximum temperature of 175° F. was obtained in the underlying $\frac{1}{8}$ - to $\frac{1}{4}$ -inch of soil when a heavy forest floor was burned under longleaf pine protected from fire for 15 years. The mean maximum temperature, based on 9 records, was somewhat less than 150° F. Six additional records were obtained from a similar fuel type located 3 $\frac{1}{2}$ miles from the area represented by data in Figure 5-A. Although the second area had been protected from fire for more than 30 years, the temperature curves obtained fell well within the range shown in Figure 5-A.

Curves D and F of Figure 5 portray soil temperature trends for fires burning in ridge type longleaf pine of the flatwoods. The only major difference between the fuel types represented by these two sets of curves was age. In both roughs, species other than grasses, such as palmetto and wax myrtle, occurred but were widely scattered. It is probable that the temperatures for fires burning against the wind were somewhat higher than normal for the 2-year rough, although no cause for this was apparent. It would seem that the difference between fires burning with the wind for the two classes of rough (as shown by the solid heavy lines) is more probable than the difference between fires burning against the wind.

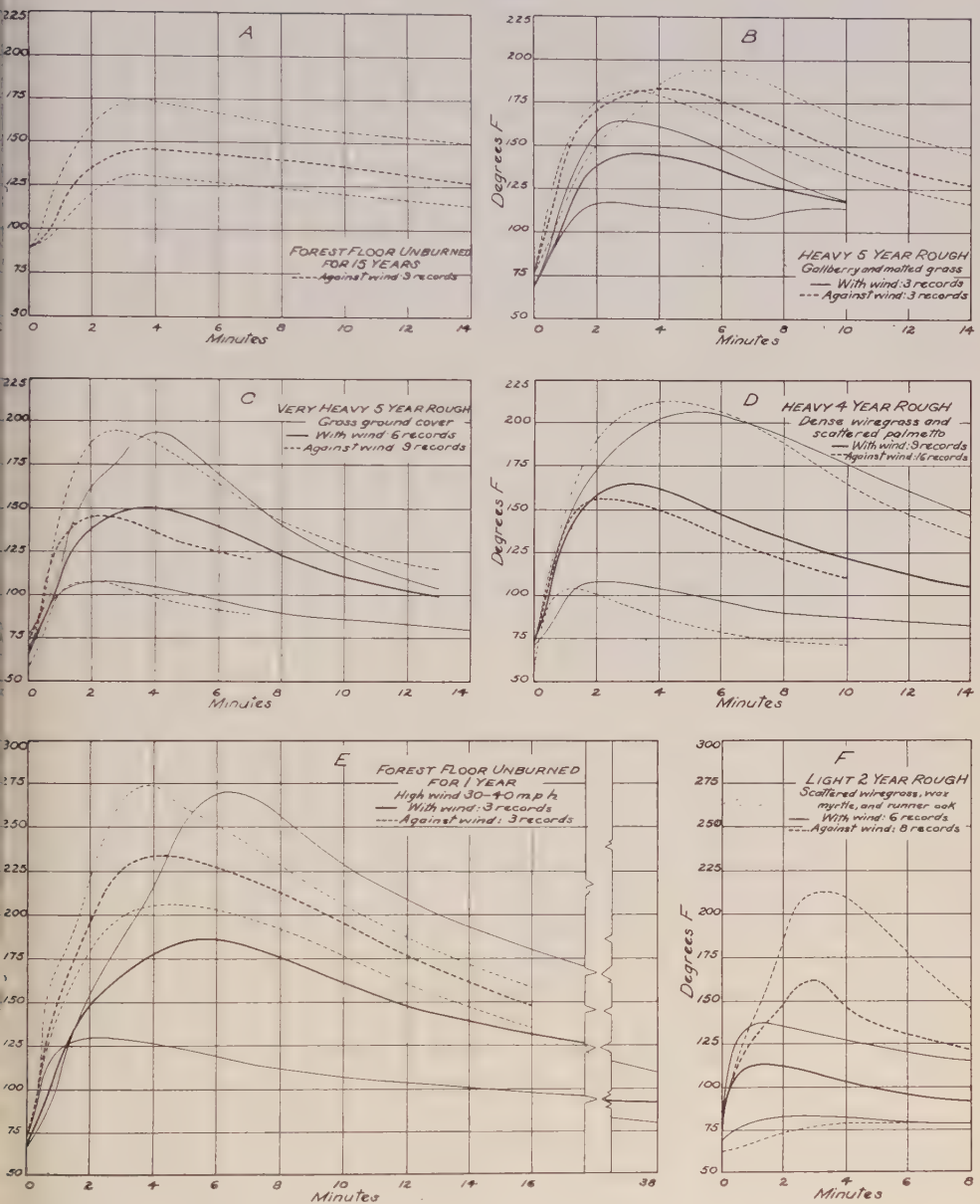


Fig. 5.—Temperature trends for the $\frac{1}{4}$ - to $\frac{1}{4}$ -inch soil depths during forest fires covering various fuel types in longleaf pine forests. Solid lines show temperatures for fires burning with the wind and dash lines temperatures for fires burning against the wind. Maximum and minimum temperature trends are shown by fine curves, and mean trends, based on all records of each class of fire, by heavy lines.

TABLE 1
DESCRIPTION OF EXPERIMENTAL FIRES

Fuel type	Description of plots ¹	General description
(1) Forest floor unburned for 15 years (Fig. 5-A).	Three plots each 5 by 20 feet; later checked by 3 additional plots on an area unburned for 30 years. A forest floor at maximum depth, consisting largely of pine needles, protected from fire for at least 15 years.	Fires burned gently into wind; flames 2 to 4 feet high; fairly clean burn. Risk too great to allow fires to burn with wind as plots were located on private land.
(2) Heavy 5-year rough of gallberry and matted grass (Fig. 5-B).	With wind: 1 plot 30 feet square. Against wind: 1 plot 30 feet square. A heavy 5-year rough of matted grass (<i>Sporobolus curtissii</i>) under dense gallberry (<i>Ilex glabra</i>) 2 to 4 feet tall (Fig. 4-B). The fire hazard was probably maximum with respect to age of development. This is the typical fuel type in which gallberry occurs.	With wind: Rapidly moving, hot fire; wind estimated 6 to 8 m.p.h.; flames 8 to 10 feet high; foliage on pines scorched up to 30 feet. Against wind: Very hot fire; backed steadily into a wind estimated at 4 to 8 m.p.h.
(3) Very heavy grass rough (Fig. 5-C).	With wind: 2 plots each 20 feet square. Against wind: 3 plots each 20 feet square. A very heavy 5-year rough, largely wire-grass, probably one of the heaviest occurring in the region (Fig. 4-A). This type occurs on moist sites surrounding ponds.	With wind: Terrific fires, flames 10 to 14 feet high, trees 40 feet high and 20 feet from plots fanned by heat; fires swept rapidly over plot; soil surface barely warm to hand. Against wind: Hot fires moving steadily against a moderate wind; flames 10 to 6 feet high; clean burn.
(4) Heavy 4-year rough of wire-grass and saw palmetto (Fig. 5-D).	With wind: 3 plots each 20 feet square. Against wind: 6 plots each 20 feet square. A 4-year rough (Fig. 3) consisting of scattered clumps of wire-grass (several species of <i>Aristida</i>), dwarf myrtle (<i>Myrica pumila</i> Michx.), runner oak (<i>Quercus minima</i> (Sarg.) Small), and saw palmetto. This is the common ground vegetation of the "ridge type" longleaf pine in the flatwoods. The rough used in the study was probably comprised of the maximum quantity of fuel inasmuch as after 5 or 6 years' protection from fire the increase in density of a grass rough is negligible.	With wind: Fires burned rapidly before a stiff breeze estimated at 4 to 6 m.p.h.; flames 4 to 6 feet high; clean burn. Against wind: Wind shifty for 2 fires causing fires to burn irregularly both in direction and in intensity for 4 fires wind estimated 4 to 6 m.p.h.; fire burned steadily in wind with flames 3 to 4 feet high; clean burn.
(5) Forest floor unburned for 1 year (Fig. 5-E).	One fire as it burned an area approximately 90 by 200 feet; fire started against wind for 1 set of records and then ignited on opposite side of plot for second set. A 1 year's accumulation of pine litter under a stand too dense for ground cover to exist.	With wind: Intensely hot fire, flames 3 to 5 feet high being kept close to ground by wind estimated at less than 20 m.p.h. (this wind blew down several trees in the general vicinity of the plot); soil surface a livid red from glowing pine needles for appreciable time after passage of flames. Against wind: Intensely hot fire; flames 2 to 4 feet high backed steadily into a strong wind.

TABLE 1 (Continued)

5) Light rough of wire-grass (Fig. 5-F).	2-year With wind: 2 plots each 20 feet square. Against wind: 3 plots each 20 feet square. A 2-year rough of the same composition as that described under 4. When 1 year old, this type of rough is frequently too sparse to burn; for this reason a 2-year rough was studied.	With wind: Flames 2 to 4 feet high as fires burned steadily before a light wind estimated at 1 to 3 m.p.h. Against wind: Fires burned irregularly into gusty, gentle breeze.
6) Heavy rough of mixed grasses (Fig. 1).	3-year With wind: 5 plots each 30 feet square. Against wind: 7 plots each 30 feet square. A heavy 3-year grass rough typical of well-drained longleaf pine sites in the inner and upper Coastal Plain (Fig. 1).	With wind: Flames 6 to 8 feet high as fires burned intensely before a gentle wind estimated at 4 m.p.h. Against wind: Flames 3 to 5 feet high as fires backed steadily into wind.

¹For practically all plots 3 distinct records were obtained, each of the 3 bulbs of the thermograph being as far apart as possible from the others.

The curves B, C, and D of Figure 5, showing temperature trends for heavy roughs, are particularly enlightening. All fires on which these curves are based were accompanied by brisk winds and occurred during a period of hot, dry weather; during the month preceding only 9-inch of rain had fallen. Air temperature varied from 75° to 94° F. during the time the fires occurred, and the corresponding relative humidity varied from 0 to 30 per cent. In spite of prevailing conditions of fuel, air temperature, and relative humidity, favorable for hot fires, maximum soil temperatures were rarely as high as 200° F. Although one fire, with flames 12 to 14 feet high, generated terrific heat above the ground, as evidenced by browning of trees 20 feet distant from the plot, the 3 maximum soil temperatures recorded were 161°, 108°, and 104° F. The fire, although creating high air temperatures, evidently swept across the highly inflammable grass rough so rapidly to heat the soil greatly.

The data pertaining to that phase of the study conducted in southern Mississippi agree with the preceding data obtained in the flatwoods of Florida. Maximum soil temperatures, as recorded by means of a copper-constantan thermocouple at a depth of 1/4-inch obtained

during 12 fires in Mississippi, are shown in Table 2. From Table 2 it is clearly seen that the soil was heated only slightly by the fires studied. For 21 temperatures recorded during 12 experimental fires, the maximum soil temperature at a depth of 1/4-inch was 138° F. In 5 instances the maximum soil temperature did not exceed the air temperature recorded prior to the fire.

The dense even expanses of grass (Figs. 1 and 2) typical of the inner and upper Coastal Plain form a highly hazardous type of fuel. During periods of low humidity and moderate wind, grass fires may sweep over the forest at a rate of at least 2 to 3 miles an hour. Flames, when burning before the wind, are frequently 10 to 12 feet or more in height and give off intense heat; but in spite of conditions so favorable for rapid, complete combustion of the herbaceous plants comprising the chief fuel, soil temperatures, even at the shallow depth of 1/4-inch, are comparatively low for the majority of the forest fires occurring in this region.

Effect of Arrangement of Fuel on Soil Temperature during Fires.—Based on general behavior, height of flames, and cleanliness of burn, it is safe to state that the fires on which Figure 5-C is based were extremely hot and were much more in-

tense than the majority of forest fires in the region. Likewise, they were judged to be more intense than any of the fires represented by temperature curves in Figure 5-B. The apparent anomaly of higher soil temperatures associated with less intense fires may be readily explained by the arrangement of fuel.

The fuel causing the less intense fire was a dense rough of grass 15 to 18 inches high. A thin layer of partly decomposed grass fragments covering the soil surface was located several inches beneath the bulk of the fuel, the intervening space being occupied solely by individual plant stems. Above this space the grass formed a tangled but well aerated mass (Fig. 4-A). The grass stand was essentially similar to a dense even-aged stand of timber in which the crowded crowns are isolated from the soil by a space occupied only by stems.

The fuel type on which Figure 5-B is based was quite different. The principal ground-cover species was *Sporobolus curtissii*, a grass which does not grow tall, but which forms a dense, well aerated, inflammable mass 4 to 8 inches deep, resting

directly on the soil surface (Fig. 4-B). Over this occurs a gallberry underbrush. A fire burning such fuel obviously would raise the soil to a higher temperature than if the fuel were separated from the soil by an air space.

Compactness of fuel and resultant poor aeration were undoubtedly the chief causes of the relatively low temperatures recorded under the forest floor unburned for 15 years. Although highly inflammable when dry, the material comprising the duff layer of the forest floor is rarely entirely consumed by fire unless the fire is accompanied by a good wind.

Effect of Wind on Soil Temperature during Fires.—The curves in Figure 5-B illustrate the importance of wind as affecting forest fires. Although practically all the fuel consisted of 1 year's needle fall, the soil temperatures while this area burned were strikingly higher than those on the area having 15 years' accumulation of forest floor. This was attributed to high wind with an estimated velocity of 30 to 40 miles per hour, blowing while the area was burning.

The temperature curves presented in Figure 5, although indicating slightly higher soil temperatures for fires burning against the wind, are not consistent in this respect. The same general trend is likewise indicated in Table 2, where it is seen that for 3 of the 8 records of fires burning with the wind, maximum soil temperatures failed to surpass air temperatures recorded prior to the fire. This was unquestionably due to the fact that the fires passed so quickly over a small spot that but little heat entered the soil.

Effect of Depth on Soil Temperature during Fires.—The range in maximum temperatures at the 1/2-inch soil depth, as recorded by glass maximum thermometers, is a noteworthy supplement to the preceding data. These temperatures varied from slightly less than air temperature, indicating no increase accompanying the fire.

TABLE 2

MAXIMUM SOIL TEMPERATURES AT A DEPTH OF 1/8- TO 1/4-INCH RECORDED DURING WOODS FIRES BURNING THROUGH A HEAVY 3-YEAR ROUGH

Fire No.	Soil temperature		Maximum soil temperature during fire	
	Air temperature	before fire	Thermocouple 1	Thermocouple 2
	°F.	°F.	°F.	°F.
<i>Fires burning against wind</i>				
1	72	56	94	B.A.T. ¹
2	80	60	—	B.A.T.
3	84	64	138	95
4	81	68	108	81
5	76	70	98	107
6	90	67	102	130
7	89	68	101	94
<i>Fires burning with wind</i>				
8	78	66	92	B.A.T.
9	80	60	85	—
10	89	68	B.A.T.	114
11	89	68	B.A.T.	109
12	84	68	113	—

¹Below air temperature.

to 195° F., for the fire burning against the wind in Figure 5-E. A mean temperature of $106 \pm 3.4^\circ$ for 65 readings was obtained for the $\frac{1}{2}$ -inch soil depth.

The slight increases of temperature at the $\frac{1}{2}$ - and 1-inch soil depths during comparatively hot fires are shown in Figure 6, in which complete 16-minute records are presented for these soil depths, as well as for $\frac{1}{8}$ -inch depths. The upper set of curves in Figure 6, showing a maximum of 144° F., was recorded in the same location as that used as a basis for the curves in Figure 5-D; however, a period of several months separated these phases of the study and field conditions varied considerably. This explains the lack of better agreement between these curves and those in Figure 5-D.

The Effect of Moisture and Texture on Thermal Conductivity of Soils.—One factor tending to keep low the temperatures shown by the preceding curves is the fact that many of the records were obtained from dry soil. The curves in Figure 5-C, however, are based on moist soil. It is well known that thermal conductivity of soil increases with moisture up to a certain percentage, after which no further increase takes place. As illustrated by Figure 7, in which curves are presented for thermal conductivity of 3 soils of widely differing texture, for each of the 3 textures conductivity of heat increases with an increase in moisture. The curve for fine sand at 25 per cent moisture represents conductivity at maximum water-holding capacity. For the fine sandy clay, thermal conductivity increased with increase in moisture up to 15 per cent, after which no further increase occurred. Curves for 20 and 25 per cent practically coincided with that for 15 per cent moisture and are, therefore, not shown in Figure 7. Likewise, curves for fine gravel at 10 and

15 per cent moisture were practically identical with that at 5 per cent.

The correlation of heat conductivity and soil moisture per cent is largely explained by the fact that water is a better conductor of heat than air, and that heat is more readily conducted from one soil particle to another if the intervening space is liquid rather than gaseous. Lyon and Buckman (6) state that heat passes from soil to water about 150 times easier than from soil to air. When sufficient moisture is present to connect all soil particles with a continuous film, further additions of moisture have no appreciable effect on thermal conductivity.

Although coarse-textured soils are better conductors of heat than fine-textured ones, owing to fewer transfers of heat per unit volume, texture is not as important as moisture in influencing conductivity. Curves for air-dry soil of widely different textures are given in Figure 7-D. These curves reveal only slight differences, the fine gravel being slightly the best conductor of heat, followed by fine sandy clay and fine sand.

SIGNIFICANCE OF RESULTS

An important point brought out by the present study is the fact that, at a soil depth of only $\frac{1}{8}$ - to $\frac{1}{4}$ -inch, the heat generated even by hot forest fires in the longleaf pine region is insufficient to destroy organic matter.⁴ Since the maximum temperature recorded in the field during this study was approximately 275° F., it is clear that soil organic matter was neither charred (and thereby made resistant to decomposition) nor destroyed by heat generated by these fires.

The effect on the soil of heat lower than that required to ignite organic matter has been widely studied. Ehrenberg (1) in his monograph on soil colloids shows that

⁴Laboratory tests made on small flakes of pine bark, on partly decomposed pine needles, and on the finest roots of wiregrass show that air-dry organic matter does not char at 350° F., provided it is within the soil and not on the surface. Slight charring occurred at 400° F.

the colloidal fraction is greatly changed by heat; because of the breakdown of the colloids, heavy-textured soils lose much of their ability to retain water when heated, and in addition, a rapid release of basic constituents occurs. He further states that although excessive heating of clay soils causes a decline in fertility, proper heating increases fertility. Heat effects on sandy soils were much less marked. Wilson (17), studying the electrical conductivity and depression of freezing point of the water extract from heated and unheated soils, found marked increases in soluble constituents after heating. Russell

and Hutchinson (9), and later Russell and Petherbridge (10), found that heating greatly stimulated ammonia production but decreased nitrification. This they explained on the basis that soil protozoa and nitrifying bacteria that prey upon bacteria were destroyed by the heat, whereas ammonifying bacteria survived. Pickering (7,8), however, denied the validity of this theory and stated that the increase in ammonia was purely chemical in nature, being caused by the decomposition of proteins by heat. He also stated that heating soil to temperatures between 60° and 150° C. caused the production of

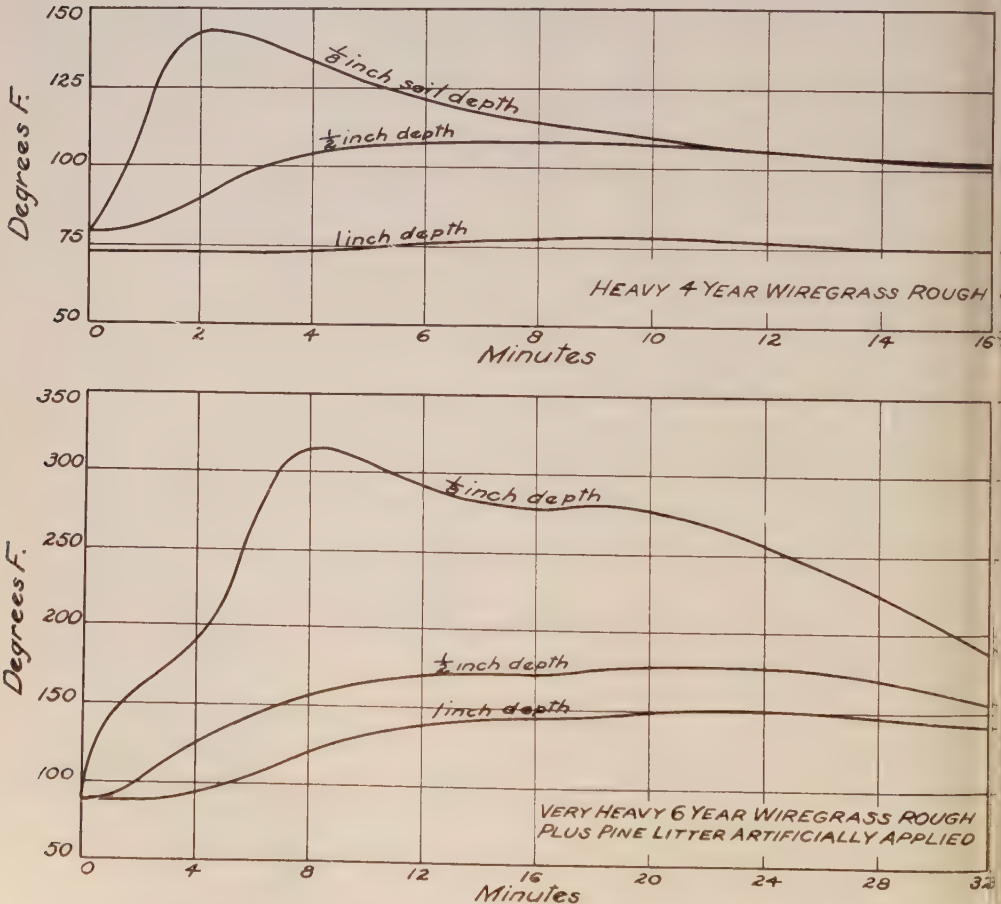


Fig. 6.—Curves of soil temperature recorded simultaneously at 1/8-, 1/2-, and 1-inch depths, during 2 fires.

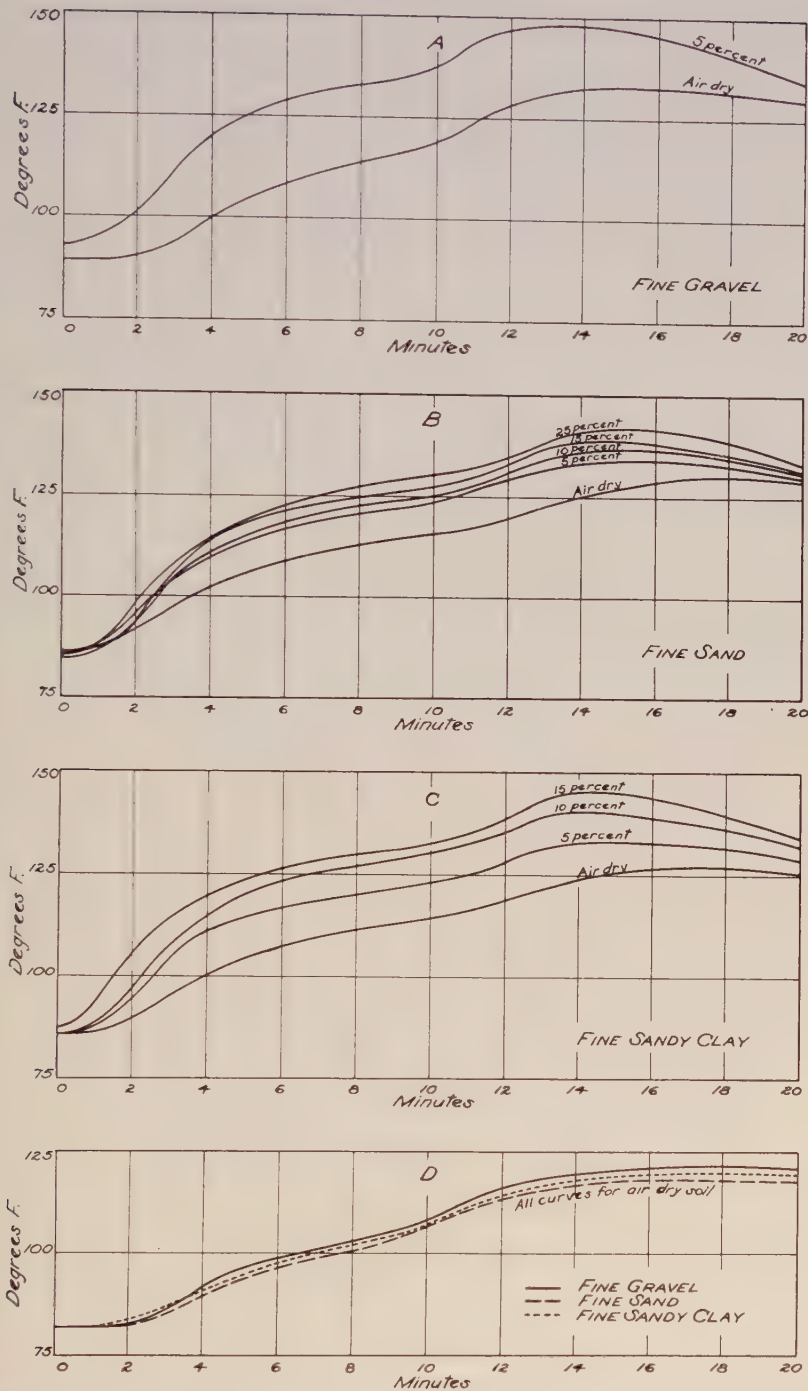


Fig. 7.—Curves showing the effect of moisture and texture on thermal conductivity of soil. All moisture percentages were computed on an air-dry basis. The pronounced dip in each of the curves has no significance; it is due to the manner in which heat was applied in determining the thermal conductivity.

a soluble organic toxin which inhibited seed germination. Elveden (2) found that heating peat soil at 100° C. for 15 minutes greatly stimulated biological activity, as judged by CO₂ evolution. Waksman and Starkey (15) found that heating soil for one hour at 65° C. resulted in an increase in number of bacteria and fungi, as well as in an increase in CO₂ and available nitrogen. Waksman (14) states: "Heating a soil even to low temperatures seems to improve it as a medium for bacterial growth."

Heating has been found to increase soluble nitrogenous compounds and also phosphorus in the soil (5, 11, 12, 13, 16). According to Waksman (14):

"The increase in the soluble matter and the changes in the micro-biological population of the soil brought about by heating result in an increase in the number of bacteria; these, in their turn, decompose more organic matter, which results in a greater liberation of available nitrogen. This favors the growth of plants."

He also points out that greenhouse soils are frequently heated to a few degrees below the boiling point of water for periods of 15 to 40 minutes; not only are pests and disease controlled in this way, but increased soil fertility and vigor of plants result.

Therefore, from the data obtained in the present study and from the review of the literature, it seems apparent that most forest fires in the longleaf pine region do not heat the soil sufficiently to decrease fertility; on the other hand, considering the effect of heat alone, it is extremely probable that these fires tend to release plant nutrients in forms usable by forest growth.

It is also noteworthy that the curves of heat conductivity, as affected by soil moisture, indicate that when field conditions are favorable for severe fires, thermal conductivity of the soil is usually at a minimum.

It should be kept in mind that only

the direct effects of heat on the soil are considered in the present paper. The important physical, chemical, and biological changes in the soil, distinct from those due to heat alone, that have been found to be associated with fires in the longleaf pine region must be studied individually before it will be possible to discuss the indirect effects of fires on the soil in the longleaf pine region.

SUMMARY

Soil temperatures were recorded during 44 experimental fires in a diversity of naturally occurring fuel types in longleaf pine forests. These records showed that, at a depth of 1/8- to 1/4-inch, temperatures were only slightly higher than those of the air and ranging up to 274° F. occurred. Maximum temperatures over 200° F. were infrequent, the majority ranging from 150° to 175° F. These temperatures generally persisted for 2 to 4 minutes, after which they declined rapidly.

Soil temperatures at the 1/2-inch depth were much lower than those at 1/8-inch. The maximum of 65 temperature records for the 1/2-inch depth was 195° F.; this accompanied a temperature of 274° F. at the 1/8-inch depth, the maximum recorded during the study under natural field conditions. For 15 of 65 records obtained at the 1/2-inch depth no rise in temperature occurred.

Only slight increases in temperature were recorded at a depth of 1 inch. For one fire, obtained by piling and burning pine straw on the soil, a maximum temperature of 313° F. at 1/8-inch was accompanied by maximum temperatures of 178° and 153° F. for the 1/2- and 1-inch soil depths, respectively.

No recorded soil temperature approached the charring temperature (350° to 400° F.) for dry organic matter within the soil.

A review of the literature reveals that numerous researches have shown consistently higher concentrations of soluble

salts and ammonia in soils heated up to 212° F. than in unheated soils. Heating to higher temperatures resulted in decreased fertility.

The above findings indicate that the heat from the majority of forest fires in the longleaf pine region is insufficient to impoverish the soil, and that the slight heat which enters the soil during these fires may even favor plant nutrition.

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GRADING OF LUMBER

By LAWRENCE W. SMITH

National Lumber Manufacturers Association

The grading of lumber starts with the growth of the tree. As the tree develops from a seedling branches are formed, some of which become large and remain in the tree as long as it lives, others die or are broken off and the stub eventually becomes covered by the wood of the tree. During the lifetime of the tree it may go through periods of drought, which affect the wood produced during that period; it may be affected by wind storms producing shakes, which are longitudinal separations of the wood fibers, and it may be attacked by fire. Pitch pockets and other variations of growth may be formed. As a result, the lumber produced from a log will vary from that which is clear and without defect to that having many defects. In addition, certain accidents of manufacture, machine damage, overstressed wood due to rough handling, cracks, broken pieces, etc., also appear in the lumber. All of these things affect the grade of lumber sawed from the tree.

LUMBER grades are determined almost entirely by the use to which the lumber is to be put. The greatest quantity of lumber fits into the general classification of yard lumber, that is to say, the lumber that is commonly handled by retail dealers. Yard lumber is the material of which America is built. The general classification of yard lumber is further subdivided into "finish" and "common" grades. There are two broad types of finish grades. One permits the use of either natural or paint finishes; the other ordinarily permits the use of paint finish only. Common lumber is the broad designation of 2 x 4's, 2 x 6's and other dimensions; boards, rough flooring, form lumber, etc. The grades of common lumber are based on their utility for general construction purposes. Appearance is not important. Defects are limited in size because of their effect on the strength of the piece, nailing properties, or covering qualities.

Lumber is also used as a raw material for remanufacturing plants, that is to say, factories which produce doors, windows, furniture, and all the variety of manufactured wooden articles. The remanufacturer is not much concerned with defects. He wants clear cuttings, some large, some small. Shop and factory lumber is the basic classification for this type

of material. Lumber which has large and possibly unsound defects or weakening defects with good clear pieces between the defective sections is in a general way of the type known as shop and factory lumber. The grades of shop and factory lumber are determined by the percentage of clear cuttings of specified size which may be obtained from the entire piece.

In addition to yard lumber and factory lumber, there is a large demand for structural lumber to be used for exacting purposes where working stresses are definitely a part of the design. To meet the requirements of this use, lumber is graded as joist and plank, beams and stringers or posts and timbers, each with a definite assigned working stress. In the structural grades of lumber, the appearance or the clear proportion of the piece is not considered; only the effect of the various defects on the strength of the piece as a whole is important.

The various grades of lumber are shown in the following tabulation.

LUMBER GRADES YARD LUMBER

Finish lumber

Grade A	}	Natural finishes
Grade B		
Grade C	}	Paint finishes
Grade D		

Common lumber

- No. 1 Boards or dimension
- No. 2 Boards or dimension
- No. 3 Boards or dimension
- No. 4 Boards or dimension

SHOP AND FACTORY LUMBER

*Firsts and seconds**Factory selects*

- No. 1 Shop
- No. 2 Shop
- No. 3 Shop
- Box

STRUCTURAL LUMBER

Graded according to working stress

- Joist and plank
- Beams and stringers
- Posts and timbers

There is probably wider interest in the use of structural lumber than in the use of any other one kind. For that reason the grading of lumber for strength will be discussed at somewhat greater length.

The basis of any structural grade is the strength value of the clear wood, which varies with the different species. Accurate strength figures of all the commercial woods of the United States are available. These data have been collected over a period of many years and are the result of hundreds of thousands of tests conducted by the U. S. Forest Products Laboratory. In preparing a structural grade, the clear wood maximum stresses are adjusted by factors of safety, effects of long-time loading, variability and size effects, thereby reducing to what are known as basic stresses. For the purpose of preparing stress grades these basic stresses are considered to have a value of 100 per cent. The stress grades are then developed by the evaluation of the effect of the various defects and are rated by percentage of the basic stress for the particular species. For example, consider lumber to be used in bending:

<i>Species</i>	<i>Modulus of rupture</i>	<i>Basic stress</i>	<i>1200 lb. f grade</i>
Longleaf pine	14,700	2333	51.5 per cent
Spruce	10,100	1466	82.0 per cent

The foregoing tabulation explains why the maximum sized knot at the edge of a 6 inch piece of longleaf yellow pine

may be $1\frac{3}{4}$ inches but in spruce cannot exceed $\frac{7}{8}$ inch if a 1,200 lb. working stress is to be developed. The determination of the effect of various sizes of defects is too involved to be discussed here. The whole subject has been worked out by the U. S. Forest Products Laboratory and is published in a very comprehensive bulletin, supplemented by tables of defect sizes for various percentages of basic working stress. For our purposes it is sufficient to state that the position of knots and similar defects is very important in pieces which are to be used for bending. For example, a knot at the edge of a tension surface is much more important than a knot at the neutral axis or at a point in a beam where the bending moment is small. Cross grain also is of greatest importance where the bending moment is maximum. Cross grain, which deviates less than 1 inch in 20 inches, has an effect on strength of perhaps 5 per cent but for ordinary purposes is not considered. The effect of cross grain increases rapidly and may account for a loss of as much as 40 per cent in strength when the slope of grain is 1 inch in 8 inches. Checks, shakes, and splits, and other defects of like character are not ordinarily important in bending but they are important because of their effect on strength in horizontal shear; consequently, in structural lumber particular notice is taken of checks near the neutral axis at the ends of beams. In yard lumber and shop lumber, checks are considered only because of their external appearance as they affect the use of the piece for finish or for clear cuttings; consequently, for yard or factory grades, checks are considered only from the standpoint of their size on the face of a piece of lumber. In structural lumber, on the other hand, no one cares about the external appearance of a check but graders and users are very much concerned with its depth. In structural lumber checks

are considered as they affect a reduction in shear area at points of greatest shear in a timber. The depth of a shake is the index of its area.

The question is often asked how the proper grade for a specific purpose may be obtained. Some users select the lumber themselves, often with unfortunate results. In recent years, however, most users have come to the realization that the grading of lumber is an art which requires training, skill, and experience. As a result, many users are depending more and more on the grading of the lumber experts of associations or sawmills, and insist that lumber used by them is identified as to quality. The common means of identification are grade marks, which are applied to lumber by trained inspectors who are licensed to grade mark by the various lumber manufacturers associations. The use of this method of identifying lumber is highly recommended because it assures the user that lumber as specified will be used in the construction of a project. In other words,

if a user specifies a 1,300 lb. compression grade of longleaf yellow pine for posts in a warehouse and includes in his specification the requirement that each piece shall be grade and trade marked, the lumber will be inspected by a qualified grader who will stamp each piece qualifying with the requirement of the grade, with the name of the grade to which it belongs. Lumber associations are of the opinion that the certification of grades by grade marks or by certificates of inspection has been an extremely important factor in the recent interest in timber structures. For example, within the past few years free standing radio towers higher than the Capitol have been built. Two-hinged and three-hinged highway arches and roof arches up to 180 feet span have been constructed and even more spectacular timber structures are in prospect. It is doubtful if engineers would have even considered lumber and timber for such uses if some means to certify the quality and the stress value of the lumber required had not been available.



NEW LOGGING NEWSPAPER

PUBLICATION of an interesting monthly newspaper called *Timber Topics* has been started by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Devoted to items and articles of interest to the logging industry, the paper will be sent free of charge to foresters who make application to the company for it. The February issue contains an article by Emanuel Fritz of the University of California, a Senior member of the Society of American Foresters, on tractor logging in the redwood regions. When writing for your copy mention the JOURNAL OF FORESTRY.

UTILIZATION OF WOOD UNDER GERMANY'S FOUR YEAR PLAN¹

UNDER the Four Years Plan the German Reich aims at replacing one-third of its total imports, i.e., 4 billion marks annually, by domestic products. The fact that wood is a material which yields a great variety of valuable products for a multitude of purposes is of immense importance in this connection. From this springs the tendency to limit as much as possible the use of wood in its natural condition for manufacturing purposes or fuel, and to replace it by some other domestic material.

The Four Years' Plan provides for the establishment of 80 manufacturing concerns having for their purpose the utilization of wood in this new sense and to be founded and run by private capital. The state will render no financial aid but offers protection by securing sales and prices for a period of nine years. Although on the strength of these guarantees more private capital than necessary for this purpose is available, the number of such concerns will be limited to that fixed by the Plan. In this connection the individual works will not, as is the case with iron works, be concentrated in certain districts, but will be scattered all over the country, preferably in places where there are facilities for wood supply.

The following description embraces on purpose some small, in part even incomplete, works of this category, as they are of a type to be established within the coming two years, some being already in the course of erection. A typical example of such a model work is the Hartplatten-Fabrik der Zenith A. G.

Hartplatten-Fabrik der Zenith A. G., Leutkirch.—This is a comparatively small concern working with three shifts of 30 men each.

The wood is cut in cutting machines, sawdust being unfit for use due to the fibres being too short. The chips are then carried to a silo by means of an elevator and deposited in a globular boiler, where they are boiled under pressure and mixed with chemical substances. The pulp is distributed in grinding machines which reduce it still further and then put under water so as to be pumped into calendering machines, where it is mixed with bakelite, the quantity of the latter being only 5 per cent. After this the pulp is subjected to pressure in three successive procedures. The first press has a built-in reservoir in which the liquid is drawn off by a vacuum. The second press works with high pressure through both heat and vacuum, and the three factors of pressure, heat and vacuum determine the degree of hardness of the plates. The third press serves as a finishing press in which the layers may be increased to any number. The plates leave this press in a finished state.

The above procedure is distinct from others (Masonite, Defibrator and Fibroplast processes) in that it is not based on paper manufacture and that no long-sieve is used. By this means the wood character is retained, the fibre is not destroyed and the wood remains equally firm in every direction. The other processes, it is true, have the advantage that the plates, as is the case in paper mills, leave the machine in one continuous strip which means accelerated production.

These hard plates are chiefly destined to replace veneer board, but they are harder and more water-tight than these and possess greater durability. They are used principally for wall panels and in-laid floors, and can be planed or carved.

¹From a report by Commercial Attache Douglas Miller, Berlin; issued by the Forests Products Division, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington.

Furniture is also made from these plates; it is covered with a thin film layer on which the grain of the wood desired was reproduced photographically.

The cost of establishing a plant of this kind is 1½ million marks, the capacity being 8,000 square meters per day.

Wubag A. G. Maschiennfabrik und Isolierrohrwerke, Buckeburg.—These words produce tubes wound from layer-wood in bands. At the moment wooden tubs are being made there from such tubes which are to serve as garbage cans, each tube section being furnished with a bottom and a lid.

First of all the ply-wood is made. To this end beech wood is placed in a machine to have the bark removed, the sheets already possessing the requisite thickness. The sheets (veneer) are then dried and put together fourfold cross-ways. Then they are glued with artificial resin and thereupon pressed; the plywood bands are shifted together and rolled up—they now represent a half-finished product.

The manufacture of tubes from plywood is very simple: Two bands of plywood are glued together in such a way that they half overlap each other. The new band thus produced is wound spirally round a cylinder and glued together to form a tube which consists of a double band-layer throughout and whose inner seams are one-half width removed from its outer seams. The tube is then placed in a mantel-press and cut into lengths. All these processes are carried out on one single machine.

The pail bottom and lid are made from short pieces of waste material. The sheets are glued together in five layers and cut into circular discs in a press. The lids are placed in a form-press, in which they are being formed through heat, a procedure for which layer-wood is particularly well suited. The pails are put together in the ordinary way.

On the premises there is also a ma-

chine factory which produces the machines necessary in this kind of tube manufacture for sale.

The Wubag-Tubes may be used as insulating or water-pipes, gutter-pipes, or for pipe-lines for oil. Their advantage consists in their insulating capacity, their small weight and the fact that wood is not a heat-conductor and does not expand when exposed to heat.

Forssmann Holz A. G., Wuppertal.—The refinement process invented by Engineer Forssmann is based on the fact that wood-fibres never break, as the tensile strength of wood-fibre is 3,600 kg per square centimeter and this strangely enough is the same for all kinds of wood. Only the intercellular connections are apt to tear. If, therefore, this tissue is removed and replaced by artificial resin the hardness of the wood is increased.

With the aid of a specially construed peeling machine possessing a perpendicular knife, tissuepaper-like sheets of a thickness of 0.1 mm. may be produced consisting of a single layer of cells lying sieve-like alongside each other so that a sheet placed on water sinks to the bottom. Fifteen such sheets are placed on top of each other, mostly, alternately with artificial resin layers of a thickness of 0.03 mm. (bakelite), which bind the whole together. Hereupon the whole substance is exposed to high pressure at a high temperature; by this means the resin is pressed into the intercellular spaces which results in a firm knitting together of the sheets.

In this way a tensile strength of 1,100 kg per square centimeter is obtained which is entirely independent of the particular kind of wood, direction of fibre or quality as that which represented quality has been destroyed. Thus cooked and knotty wood may be used without disadvantage. Forssmann-wood is so nearly impermeable that its absorption of water is no longer measurable, it does not rot or warp; the

wood is dead. Further properties are special smoothness, pressure-resistance, and elasticity. By using a covering metal sheet a perfect combination of wood and metal is obtained. Thin plates form a most plastic material of any desired elasticity and therefore are most suitable for the manufacture of cigarette cases.

Forssmann wood is used for veneering furniture or walls, which latter may be scrubbed. The veneer is ironed-on on top of a sheet of artificial resin. Moreover, on account of the infinite thinness of the sheet the kind of wood used scarcely affects the price. This wood is chiefly suitable for the building of models and further for the manufacture of airplane plates, insulation board, and wheels for roller skates. Even a circular saw has been constructed of this material which is said to have done very well. At present the firm is experimenting with a "carrying roof" doing away with the necessity of a supporting frame. Further it is contemplated to make gutter pipes and wastepipes of this material similarly to what is done at the Wubag. The costs of establishment are comparatively moderate, amounting to about 100,000 marks.

Marxen-Stopfen G. M. B. H., Berlin.—A small workshop situated on the fourth floor of a tenement house where elastic bottle-corks are being made from poplar wood. The poplar wood pieces, cut in the requisite dimensions, are automatically turned into corks of various shapes and sizes. In order to give them the necessary elasticity the corks are then cut from above till fairly deep down into the interior by means of a circular knife, whereupon they are impregnated by way of dipping and covered with a non-odorous lacquer. The stamping must then be done on the convex top by means of a special process.

To facilitate the drawing of the corks some of these are furnished with a roll round the top. Here a tong-shaped bottle-

opener may be used to draw out the cork without injuring it.

The elastic wood cork is meant to replace corks which have to be imported from abroad. It has the advantage that it is almost unbreakable, has scarcely any odor, and not so great a tendency to the formation of fungi.

Zellstoff-Fabrik Waldhof, Mannheim.—

This is the largest German pulp factory, having a capacity of 800,000 cubic meters of wood. The wood used is chiefly spruce (Fichte) of which up to 70 per cent has to be imported. In order to become more independent of imports and yet to make available the requisite quantities of spruce for the manufacture of pulp, the necessity has arisen under the Four Year Plan of replacing spruce pit-props by those of pine (Kiefer). Pine wood may also be used for the manufacture of some kinds of paper. The wood of leaf trees, on account of its short fibre, which is unsuitable for the infiltration process, can only be used for the manufacture of pulp, when this has to serve for the further manufacture of rayon and staple fibre (Zellwolle).

The wood is used after removal of the bark. The process of removal has proved more economical if done by a combination of manual and machine power in such a way that the machine does the rough work, and the finishing is done by hand. The chopping is done by machine by means of rotating knives.

The cellulose is won from the chips by the sulfite process. A special plant is necessary for the preparation of the sulfite lye. The sulphuric acid gained by the burning of sulphur is cooled down and run into high towers of larch wood filled with limestones which are irrigated from above with water, whereby sulfite lye is produced. The chips are carried to elevated bunkers by means of elevators and from here they are poured into the brick and cement sulfite boilers. In these

the wood is boiled in the sulfite lye under high pressure at a temperature of 150° for 12 hours, in which process the Lignin is dissolved, while the cellulose is not affected. The cellulose "broth" runs into a ditch with a filter bottom. The encrusting wood substances, which would render the paper brittle are eliminated in this way together with the lye. The fibre pulp is now led through a chloride plant into bleaching vats where it is washed and bleached as would be the case with paper pulp.

Two-thirds of the resulting cellulose pulp is made into white cellulose cakes, being carried over sieves, felt bands and drums. One-third of the pulp is conducted through a long pipe into the adjoining paper factory, where various kinds of paper (such as packing paper, parchment, type paper, and embossed pergamines) are being manufactured in the usual way, for which purpose the cellulose pulp must be first ground finely.

In the Zellstoff-Fabrik Waldhof waste products are utilized in their entirety, i.e., the sulfite lye with the encrusting wood substances. There is an alcohol factory on the grounds where the sulfite lye is mixed with yeast. The sugar gained in this way is fermented into alcohol and this in turn distilled into 100 per cent spirit for motors.

Furthermore, there is attached a plant for the production of tanning extracts from the waste sulfite lye. It is dried in big drums to powder in a similar manner as the production of dry milk. This tanning substance in conjunction with the bark furnishes a valuable tanning extract for leather manufacture, the results obtained therewith being equal to those obtained with oak tan. It has not, it must be admitted, been ascertained whether the leather treated herewith is suitable for prolonged storing as is necessary for military purposes.

It is finally contemplated to utilize the

waste lye in connection with soap production as it possesses eminent rinsing power. It is the intention to increase the cleansing effect of soap and thus to gain a possibility of replacing imported fatty acids. A disadvantage in this connection is that the suds are not white in color.

It is highly interesting to look into a model works for the manufacture of rayon by the Viscose process as described later in the staple fibre factory of the I. G. Farbenindustrie A. G. The production of rayon and staple fibre is identical up to the introduction of the thread into the spinning bath. Here, however, the thread produced in the rayon manufacture is first twined and only hereupon passes into the various chemical solutions to be cleansed, as the rayon thread of course, as a proper thread is being further utilized in the textile industry without the spinning process. The purpose of this experimental workshop is to ascertain which properties of the cellulose are noticeable in the further utilization in rayon manufacture. An experiment is being made there with cellulose from eucalyptus wood in order to ascertain whether the great eucalyptus woods of Spain can supply raw material for rayon manufacture.

Zellstoff-Fabrik Waldhof forms a gigantic block, in which the individual plants, i.e., the wood-chopping plant, the plant for producing sulfite lye, the fibre factory proper, the paper mill, the alcohol factory the plant for production of tanning extract and the experimental artificial silk works, are incorporated in an ingenious fashion. The cellulose produced here is sold exclusively in the domestic market.

Zellwolle-Fabrik der I. G. Farbenindustrie A. G., Wolfen.—The staple fibre (Zellwolle) produced at Wolfen bears the designation "Vistra." At first this substitute was regarded with suspicion in Germany. It was only when important consignments of Vistra went to the U. S. A. and returned as finished products to

Germany that it was recognized that this was not a substitute but a valuable new product to be likened to cotton. In quality Vistra corresponds to North American cotton but possesses less water-resistance. Promotion of the production of Vistra forms an important chapter in the Four Year Plan all the more as textiles represented by far the greatest proportion of Germany's total imports. Thus cotton has to be imported in its entirety, the annual figure being until quite recently 360,000 tons. Under the Four Year Plan 150,000 tons of Vistra will be used annually—equalling 1 million cubic meter of wood—as a 25 per cent admixture to practically all natural fibre materials. The latter are hereby improved and rendered firmer without a lessening of the water-resisting capacity. Consequent upon this regulation the possibility exists at the moment of a production of 70,000 tons of Vistra annually in Germany.

Contrary to the procedure at Waldhof, common beech is exclusively utilized for staple fibre manufacture, as the fibre of this wood is shorter than that of spruce or pine (leaf tree fibre 1 mm., spruce fibre 3 mm.). In the manufacture of cellulose for staple fibre or rayon this circumstance is immaterial as the fibre mass has in any case to be dissolved in order to be spun. About 250,000 cubic meters of wood are stored here, the annual requirement being 360,000 cubic meters. The wood is of good fuel quality having been peeled in the forest, but not trimmed and supplied cut into billets. For the purpose of unloading the truck is rolled onto a turning-table and with the aid of automatic machinery the truck is tilted and the wood emptied into a low-lying reservoir, from which the floating wood is then again automatically ladled out and distributed on the place of storage.

Here the fibre, as in Waldhof, is subjected to the sulfite process. The sulfite boiler, in which the chips are boiled in

the sulfite lye, has a capacity of 250 cubic meters. It is not of brick and cement as here chrome-nickel-steel is being used for the first time, this metal being impregnable against the lye. The seams are not riveted but welded together and are examined with special care by means of X-rays. Above the boiler, in the next storey, there is a bunker which holds 4 carloads of chips. The vats in which the watering and bleaching is done have the appearance of gigantic tiled swimming pools. The finished fibre material reaches the stable wool factory in the form of white, square cakes. It is however contemplated no longer to supply fibre in solid shape but to conduct it to the fibre factory in pulp without the intervening solidifying stage. The final phase of the cellulose manufacture (the milling machine with its sieves and drums) would thereby become unnecessary and the process of manufacture from wood to wool would be made continuous. This project has not as yet been realized in practice.

The manufacture of staple fibre begins in the uppermost storey and is continued downwards through the successive storeys. The fibre plants are placed in diving presses where they are dissolved in caustic and turned into alkali-cellulose. The excess quantity is run off and the pulp reduced in unravelling machines. The cellulose must then be matured. The I. G. Farbenindustrie A. G. has a new procedure for maturing which reduces the term to 24 hours. For this purpose the alkali-cellulose is filled into so-called maturing drums which turn round slowly. Hereupon the matured cellulose runs into the next story through funnels to be mixed with sulphuric carbon disulphide in the sulfidizing drums. The pulp emerges as a yellowish-brownish mass, called "xantfogenate" which is so highly explosive that only bronze tools may be used and the room has to be constantly ventilated. Only in this xantfogenate-stage the pulp is soluble in carbon lye. It is therefore

mixed with thin carbon lye in the dissolving vat and the result is a honey-like orange-red fluid, the "viscose" or spinning liquid, which is deposited in the 60 cub.m. reservoir where it has to remain for some time.

The liquid is subsequently, after the passing of filter candles through the tiny openings in spinning nozzles, pressed into a spinning bath consisting of diluted sulphuric acid. At this moment the xantfogenate is dissolved and the regenerated cellulose emerges as a thread. The spinning nozzles, which represent a masterpiece of German technique have 2,500 openings on a circular surface of a diagonal of 5 cm, the diameter of the openings being 0.07 mm. Hence 2,500 threads emerge from one single nozzle, that is 450,000 threads out of one machine which pass on united into a single band. This, having been soiled by the sulphuric acid, is now cleansed in a succession of lotions, being squeezed out in between by means of cylinders while the band constantly moves on with the original spinning velocity. It is then cut into lengths, the pieces being loosened in a curling bath and subsequently conveyed to the drying plant. The Vistra leaves the works in the form of snowy-white, soft flakes, packed in bales.

In the Wolfen works there is a technical experimenting department, a spinning mill where all spinning problems arising within the works may be demonstrated in the presence of customers. There is a flax-mill and such for the spinning of worsted yarn, cotton and carded wool. And everywhere a 25 per cent admixture of vistra is being used.

The Zellwoilfabrik has at present a working staff of 8,000 and the annual output is 50,000 tons of staple fibre. The I. G. Farbenindustrie A. G. factory is a building of monumental beauty and the interior with its spacious ample work-rooms with walls tinted a light color and

machinery painted light grey offers a bright and harmonious aspect. The social facilities are of a model character, as for instance the almost luxurious bathing establishment with its tiled shower rooms and the canteen. The arrangements regarding workmen's dwellings are of a novel kind. A worker, after having been passed by a doctor as free from any hereditary illness, and having given 1,600 hours of his spare time to assistance in the building of workers' dwellings under the guidance of skilled builders, has acquired the right to move into a dwelling at a monthly rent of 20 marks. This monthly payment also includes the amortization of the loan extended to him partly by the Government, partly by the I. G. Farben in this connection, so that he becomes the owner of the house after a number of years.

Bergin Ag. Fuer Holzhydrolyse, Mannheim.—In these works the procedure is exactly the opposite of that used in the Zellstoff-Fabrik. There the lignin was dissolved and the cellulose won in this way, here the cellulose is dissolved and saccharified and the lignin remains. Professor Bergius works, contrary to the Scholler procedure described later, with concentrated hydrochloric acid and without overheating (32 centigrade) whereby valuable substances are preserved.

The chips are made by means of a special rasping machine from roughly peeled logs, whether coniferous or leaf wood is immaterial. The bark is no hindrance, although on the other hand it yields no sugar. Sawdust may only be used in a proportion of 20 per cent as the hydrochloric acid would not penetrate entirely if only sawdust were used.

During the first part of the process the chips, previously dried, are macerated in a concentrated hydrochloric acid bath (hydrolyzed) whereupon the sugary hydrochloric acid is drained off. The lignine remains behind and is at the moment

being used for fuel only. At the second stage of manufacture the hydrochloric acid is evaporated and drawn off by vacuum, whereupon it is available for further use. There remains the acid-free sugar solution which is dried in a similar way as milk and which may be utilized in four ways as follows:

- (1) The wood sugar may be used in the place of imported barley for mixing with silo fodder;
- (2) It may be fermented with yeast into alcohol;
- (3) It is used as base for the production of yeast;
- (4) It may be crystallized into grape-sugar, which may also be done in an existing sugar factory, any waste being used for the production of alcohol.

Grape-sugar is not as sweet as beet-sugar and is therefore less suitable for sweetening coffee. It is, however, particularly suitable for the manufacture of candies and marmelades. By addition of grape-sugar, furthermore, skim-milk may be turned into full-cream milk. Grape-sugar has also the advantage that it can be produced during any season.

Prof. Bergius designates as optimal size a factory producing from 100,000 cubic meters of wood annually a quantity of 20,000 tons wood-sugar. The construction of such a plant costs 5 to 6 million marks. This output may be reduced by one-half, but a plant utilizing less than 50,000 cubic meters of wood is not considered remunerative. For this reason it is not feasible to establish a kind of portable plant in the vicinity of woods. This plant represents an experiment and is to serve as pattern for 10 plants yet to be established under the Four Year Plan.

Versuchsanlage der Wirtschaftlichen Vereinigung der Deutschen Hefeindustrie, Tornesch. (Experimental Plant of the Economic Association of the German Yeast Industry).—This establishment represents

an experimental plant operating on the basis of the Scholler Procedure, after the pattern of which industrial concerns are to be established later. Only evergreen or needle tree woods are suitable in this connection, but any quantity of fine saw-dust can likewise be used. The requisite material is obtainable from surrounding wood-works.

The chips in an undried condition are filled into percolators, whereupon a steam press permeates them with diluted (0.8 per cent) sulphuric acid, which trickles through the chips. During this process cellulose is dissolved and sugar formed, which is removed as quickly as it is formed. The wood is thus transformed into sugar and lignin two-thirds of the former and one-third of the latter, which remains in the percolator at the end of the process.

The sugar mass is then cooled down from 120° to 70° centigrade and carried to the clarifying vats, which are filled with limestone and chalk with the addition of salts. The lime neutralizes the excess of sulphuric acid and renders it latent which causes the formation of plaster which must be removed at the end of the process. The sugar solution, freed from acid, is now passed through filtering machines, whereupon it is cooled down to 30° centigrade in spiral cooling machines.

This neutralized and clarified sugar solution may now either be fermented into alcohol in an air-tight space or be transformed into yeast for fodder. In either case, however, yeast as well as alcohol will result. For the purpose of alcohol production the sugar solution is placed in fermenting vats and mixed with yeast. The excess of yeast is removed in separators and is again available for further use. The distilling is done in the usual way, the alcohol being repeatedly evaporated and condensed in a distiller until finally the alcohol, containing 94 per cent

of pure alcohol ensues. From 100 kg of dry wood substance 21 liters of alcohol are gained.

For the manufacture of yeast the sugar solution is placed in fermenting vats provided with an airing and cooling contrivance, as the process of fermentation engenders heat. In order to cause a formation of small, effective air bubbles the air is introduced through cermaic candles. By means of the nitrogen in the air yeast is gained from the sugar solution, the years growing rapidly while at the same time the sugar serving as base decreases and is used up. The fermentation cells are then removed from the mixture by means of separators; the remnant is not fit for use. The wort is dried through cylinders under vacuum suction. From 100 ky dry wood substance 30 kg feed-yeast may be gained. The yeast thus obtained has the same nourishing value as beer yeast, serves as a substitute for oil cakes and may also be used for feeding horses.

Dessauer Zucker-Raffinerie.—This is the industrial realization of the experiments carried out at the concern of Tornesch (Scholler system). From the storage place, where there are lying at the moment 50,000 cubic meters of coniferous wood, the chips are carried to the works in a pipe of a length of 560 meters, where they are through air pressure lifted up to a height of 48 meters and pressed into "Zykbne." The sugar producing plant possesses 8 percolators of 10 meters' height each of a capacity of 10 tons of dry hard substances. It is intended to increase the number of percolators to 12. These have an inner double stone coating followed by a protecting layer of lead, the outer coating being an iron mantel. Percolation is effected under a pressure of 18 atmospheres. In order to remove the lignin remaining after the process this is placed under pressure, whereby it is formed into a moist, hard cake which falls out as if through an explosion as soon as

the percolator is opened, and thus the latter is left free for further use.

Lignin is at present used chiefly for fueling and its price is 30 marks per ton. As it does not leave any ashes it is also suitable for use in coaldust motors. Mixed with peat and pressed into briquets it constitutes as peat coke a very valuable fuel. Experiments are also being made at this time in order to try whether lignin may not be used in conjunction with other substances to substitute artificial resin. It would then be a factor in the manufacture of hard plates.

In this procedure only alcohol is won, and on feed-yeast.

Advantages and Disadvantages of the Scholler and Bergius Processes.—The main difference between these two procedures is that Bergius works with low temperature and concentrated hydrochloric acid and Scholler with high temperatures and diluted sulphuric acid. Both systems possess strong and weak sides and hence it has been decided to run half the concerns to be established according to the Bergius and half after the Scholler principles.

The advantages of the Bergius system are:

(1) Due to the low temperature a higher yield is possible than is the case of the Scholler system. It is therefore better in the case of grape-sugar production. The system is also more suitable for the production of a number of chemical substances (like "pentosan") because these substances are not destroyed in the process. The possibility of obtaining such substances means a saving.

(2) The hard wood sugar produced in this process is capable of being transported and ready for immediate use which is not the case with Scholler's liquid sugar.

(3) In it both leaf and coniferous wood may be used, while the former in Scholler's system is not capable of percolation. The Bergius system is therefore

preferable where leaf wood is available for manufacture.

The advantages of the Scholler system are:

(1) Here a simpler and essentially cheaper plant suffices. A plant destined for utilization of 100,000 cubic meters of wood costs $3\frac{1}{2}$ million marks. One after the Bergius system costs 5-6 million

marks.

(2) Scholler's system provides for the use of 100 per cent of sawdust. Bergius' only uses 20 per cent. The Scholler system is therefore to be preferred where it is a case of utilizing mainly sawdust, which in most instances is favorable as its transport does not cost much when it is pressed into solid shape.



THE National Forest Reservation Commission reports that since the passage of the Weeks Law in 1911 and the Clarke-McNary Law authorizing the federal purchase of land for forests, it has approved the purchase of 15,994,577 acres, of which 14,239,621 acres have been paid for and title permanently vested in the federal government.

Up to June 30, 1937, the following total acreages by states have been approved for purchase by the National Forest Reservation Commission:

<i>State</i>	<i>Total acres</i>	<i>State</i>	<i>Total acres</i>
Alabama	441,888	New Hampshire	663,116
Arkansas	984,440	North Carolina	878,753
California	86,286	North Dakota	480
Florida	674,162	Ohio	38,410
Georgia	514,772	Oklahoma	143,823
Idaho	1,128	Oregon	6,595
Illinois	151,277	Pennsylvania	424,445
Indiana	34,256	Puerto Rico	10,341
Iowa	100	South Carolina	494,127
Kentucky	385,656	Tennessee	521,122
Louisiana	484,659	Texas	629,649
Maine	47,513	Utah	38,083
Michigan	1,666,224	Vermont	160,720
Minnesota	1,200,944	Virginia	1,224,812
Mississippi	925,804	West Virginia	874,110
Missouri	1,016,915	Wisconsin	1,269,967

LUMBER PRODUCTION FOR THE NORTHERN ROCKY MOUNTAIN REGION

By I. V. ANDERSON

Northern Rocky Mountain Forest and Range Experiment Station

Lumbering is one of the most important industries in the Northern Rocky Mountain Region. The following article describes trends in this industry from 1869 to the present time.

THE Northern Rocky Mountain Region with the exception of the lower eastern slopes of the Rockies is primarily a forested region. It constitutes a logical administrative unit of the U. S. Forest Service that includes Montana, Harding county in South Dakota, Idaho north of the Salmon River, and Spokane, Stevens, and Pend Oreille counties of northeastern Washington. Lumber manufacture is one of the principal industries of this region. For the past 35 years the payrolls of many communities have been furnished almost entirely by sawmills and associated logging operations. These mills vary in size from the small circular mill capable of sawing only a few thousand feet of lumber per day to the plant of Potlatch Forests, Inc., at Lewiston, Idaho, capable of sawing a million feet of lumber every 24 hours. At the present time approximately 15,000 wage earners find work for the better part of the year in this basic industry which has a population of 60,000 people directly dependent upon it for their livelihood. The payrolls of sawmills and subsidiary logging operations are at this time directly sustaining about 7½ per cent of the population of the entire Northern Rocky Mountain Region.

Commercial lumbering started in Montana on a substantial scale in the late eighties to supply the needs of the copper mining industry. At the present time 95 per cent of the lumber cut in Montana comes from the nine counties west of the Continental Divide. Development

of the commercial timber stands of northern Idaho, which now furnish 85 per cent of Idaho's lumber cut, did not start in a big way until about 1905. At that time a diminishing cut of eastern white pine (*Pinus strobus*) in the Lake States opened eastern markets to the producer of western white (Idaho) pine (*Pinus monticola*).

The development of the lumber industry in the Northern Rocky Mountain Region as a whole, since 1869, is graphically portrayed by Figure 1. The basic data for this figure were obtained by the Forest Service under cooperative agreement with the U. S. Bureau of Census.

As indicated in Figure 1, ponderosa pine (*Pinus ponderosa*) and western white pine have been the principal lumber species since lumbering began. For many years the cut of ponderosa pine lumber exceeded that of western white pine. However, in 1927 lumber production of the latter species forged ahead and has exceeded the output of ponderosa pine by 50 to 250 million feet annually. This transposition was largely due to (1) construction of a white pine mill of unusually large capacity in northern Idaho and (2) exhaustion of the more accessible ponderosa pine stands in northern Idaho concurrent with the development of large tracts of this timber species at lower cost elsewhere in the west.

The production of lumber from the secondary species of the Region has always been relatively low. Even though the present standing timber volume of these species is three times the timber

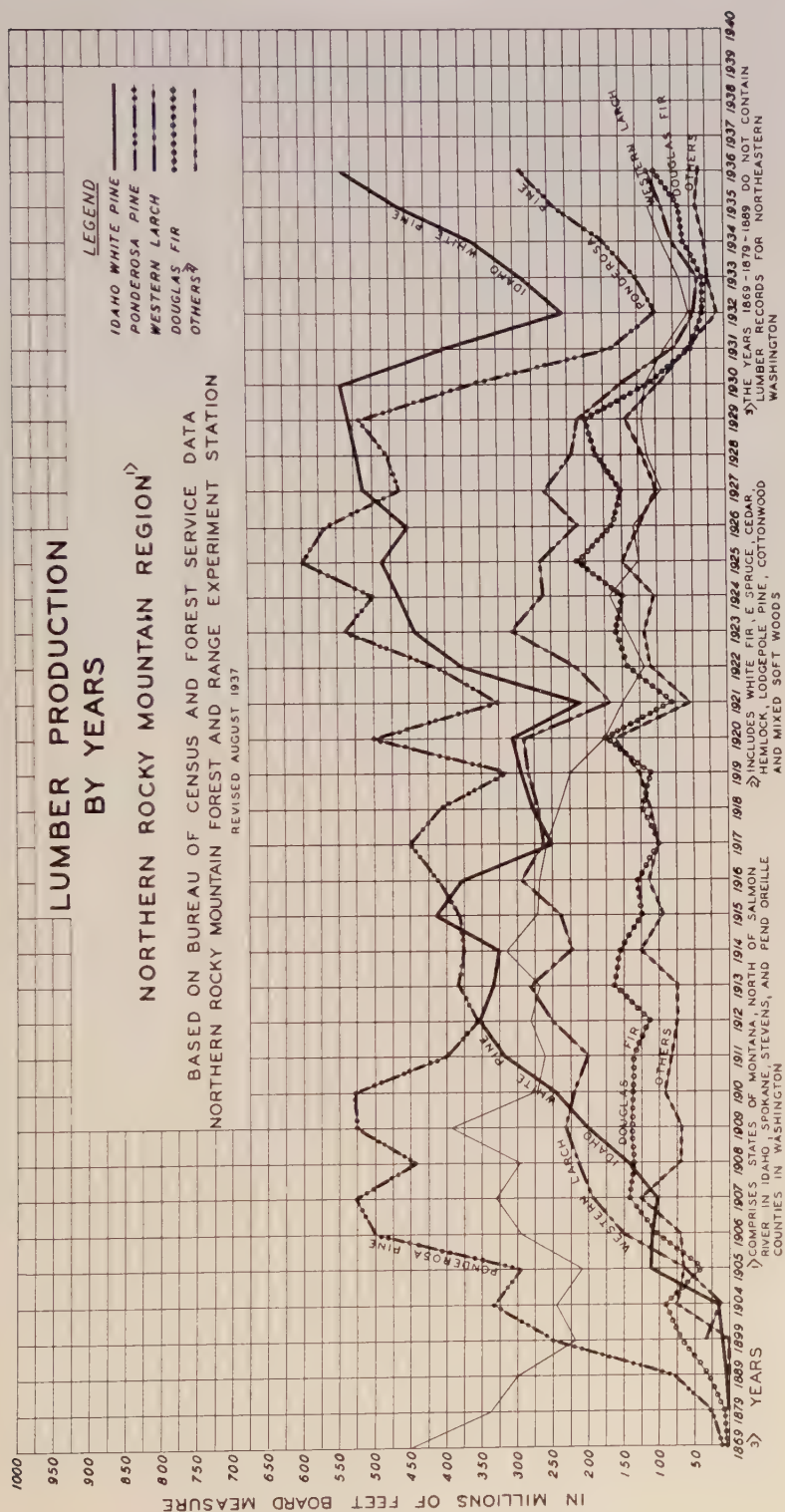


Fig. 1.—Lumber production by years in the Northern Rocky Mountain region.

volume of the two pines, the present cut is only 23 per cent of the total lumber cut for the Region. The relatively small cut of secondary species as indicated by the chart is not due to their scarcity but to lack of sufficient and profitable markets.

A comparison of the trend in production of western white pine lumber with production of white pine in an older lumber producing region is shown in Figure 1. The light unlabeled line shows that production of eastern white pine in Maine remained quite constant for 25 or 30 years, then experienced a gradual decline. Consulting another source of information for further comparison it is noted that in Minnesota eastern white pine lumber production suddenly rose to a peak of $2\frac{1}{4}$ billion feet in 1899, gradually declined for 25 or 30 years, then plummeted downward to the present production of about 60 million feet. It is too early in

the history of forest exploitation in this Region to predict whether the production of western white pine lumber will follow the gradual declining tendency of the Maine production or the more precipitous nose dive of white pine production of Minnesota.

Figure 1 is only one part of the annual lumber production data released by the Northern Rocky Mountain Forest and Range Experiment Station. In addition, data are prepared in tabular form showing lumber production by species since 1869 for northern Idaho, northeastern Washington, and Montana, as well as a summary table for the entire Northern Rocky Mountain Region.

Production data of this kind become only of historical value unless revised currently. For this reason they are brought up to date annually by addition of figures for the preceding year.



CLARENCE C. OLSEN, a Senior member of the Society, died suddenly January 1, 1938, after a two-day illness, at Enterprise, Oreg. Olsen was born December 22, 1898 at Chicago, Ill., served in the Navy during the World War, graduated from the University of Idaho Forestry School in 1926, and entered the U. S. Forest Service in June 1926. He subsequently worked on the Deschutes, Willamette, Siskiyou, and Wallowa National Forests in Oregon in various positions from District Ranger to Assistant Forest Supervisor. The Society loses an energetic and idealistic member who was intensely interested in the forestry profession.

EXPERIMENTS WITH CHEMICALS IN KILLING VEGETATION ON FIREBREAKS

By G. J. IKENBERRY, H. D. BRUCE, AND JOHN R. CURRY

California Forest and Range Experiment Station

To meet the need for economic methods of maintaining firebreaks, the California Forest and Range Experiment Station has been experimenting with the use of chemicals, first to kill sprouting stumps, and second, to sterilize soil. The results with various chemicals, including chlorates, arsenic compounds, and petroleum oil, are presented.

DEVELOPMENT of forest fire control facilities in the chaparral forests of southern California has included the construction of an extensive system of firebreaks. In the four southern California National Forests there are over 2,500 miles of such improvements, 40 to 100 feet in width, constructed over the past 30 years at an expenditure of approximately \$2,000,000. In addition, the Forestry Department of Los Angeles County maintains approximately 175 miles of breaks outside National Forest boundaries. Justification for this development is found in the high inflammability of the chaparral, the difficulty of fire line construction, and the great risk to human life and improved property involved in the destruction of the watershed cover.

Firebreaks in the Sierra Nevada and Coast Range forests of northern California until recently have been limited to a few areas, principally in the southern Sierra foothills, where these barriers have been located between the highly inflammable brush and woodland types and the commercial forests of the higher elevations. Records show a gradual retreat of valuable tree species on the lower foothills as a result of past fires starting near the valley floor and sweeping into the timber on broad fronts. In 1933 a project was undertaken under the Emergency Conservation program by the U. S. Forest Service and the California Division of Forestry to connect these scattered firebreak sections and to extend them into a

break running continuously between the commercial timber and woodland types along the east and northwest sides of the great interior valley. This firebreak, called the Ponderosa Way, now 90 per cent complete, will be over 600 miles in length. The width varies from 50 to 150 feet, depending upon the vegetation and the topography. In contrast to the breaks of southern California, the Ponderosa Way does not present an entirely bare appearance. Trees which will not seriously reduce effectiveness are allowed to remain, resulting in a heavily thinned stand from which all snags, down logs, and low vegetation have been removed. A motor way is an integral part of the Ponderosa Way system wherever topography permits. Occasional spur breaks have been constructed to give additional suppression facilities in highly hazardous sections. Throughout northern California, there are in all approximately 700 miles of firebreaks.

Firebreak expense is not confined to the original construction cost. At intervals of not more than three years the breaks must again be cleared and the cost of so maintaining a break by ordinary hand and machine methods is usually 10 per cent of the initial construction cost. On this basis, the cost of maintaining the present system of firebreaks in California is in the neighborhood of \$100,000 per annum. Tractors and other maintenance machinery can be used on, roughly, 50 per cent of the firebreaks; the remainder

must be cleared by hand methods.

Following the clearing of a break the stumps of certain broad-leaved species sprout vigorously. Some, evergreen in habit, as manzanita and live oak, are particularly undesirable because of their inflammability and fire-spreading characteristics. In place of the plants completely killed by the initial clearing, a new crop of seedling shrubs and, frequently, a heavy stand of annual vegetation springs up. In the central and southern Sierra, the low, dense-growing shrub, bear clover (*Chamaebatia foliolosa*), is particularly hard to eliminate because of its strong sprouting capacity.

The California Forest and Range Experiment Station has, since 1933, conducted experiments to determine the possibilities of reducing costs of firebreak maintenance through the use of chemicals. Two problems have been studied, first that of treating stumps to prevent sprouting, and second, treating soil to kill low vegetation already established and to prevent reseeding. The approach to each problem and the results so far obtained are explained in the following sections.

STUMP POISONING

These experiments consisted in treating individual stumps with varying quantities of several chemicals at all seasons of the year. In all, over 2,200 stumps were treated. Each was marked with a numbered metal disc for subsequent identification and inspection. Stumps were treated in several different localities, representing different soil and climatic conditions.

Table 1 is a summary of results of the stump poisoning experiments, showing the percentage killed irrespective of all conditions other than the chemical employed. The results are for single, not repeated applications. In classifying the stumps following treatment, none were considered "killed" which showed any sprout development regardless of size or thriftiness. The sprouts which develop from stumps

poisoned by the more toxic chemicals are invariably so few in number and so localized that they are easily killed by a second application. Hence, the true effectiveness exceeds the figures listed in Table 1.

Acid sodium arsenite is an economical and potent herbicide. All stumps to which this poison is properly applied will be killed by a single application. Failure of the first application to achieve a perfect kill is invariably the result of girdling which is either incomplete or so high on the trunk that the poison does not reach all portions of the crown tissue from which sprouts develop. In usual practice, 80 to 90 per cent of the stumps will be killed with the first application. Of those which survive this initial treatment, vigor is greatly reduced and the kill can easily be completed by a second application to that part of the stump from which sprouts have reappeared.

TABLE 1

RESULTS OF TREATING STUMPS OF VARIOUS SPROUTING SPECIES WITH SPECIFIED CHEMICALS

Chemical	No. of stumps treated	Percentage killed
Sodium chlorate _____	59	97
12.5 per cent solution		
Sulfuric+arsenic acids _____	29	90
(1:1) 25 per cent solution		
27° API Diesel oil _____	565	88
Acid sodium arsenite solution _____	894	83
(NaH ₂ AsO ₃ +H ₂ AsO ₃)		
Ammonium thiocyanate _____	11	82
25 per cent solution		
Arsenic acid _____	27	78
20 per cent solution		
Tri sodium arsenite _____	16	75
25 per cent solution (Na ₃ AsO ₃)		
Sodium chloride _____	174	65
Bleaching powder _____	4	50
Sodium hypochlorite _____	6	50
5 per cent solution		
Pyridine _____	4	50
32.8° API Diesel oil _____	300	20
Sulfuric acid _____	9	11
25 per cent solution		
Cupric sulfate _____	6	0
25 per cent solution		
Ferrous sulfate _____	8	0
25 per cent solution		
Carbon bisulfide _____	13	0

The acid sodium arsenite is prepared by dissolving arsenic trioxide (As_2O_3) in a hot solution of sodium hydroxide (NaOH). Eight pounds of arsenic trioxide are stirred with one quart of lukewarm water to a smooth paste. Three more quarts of water are added and into this suspension two pounds of sodium hydroxide are cautiously stirred. The resulting stock solution is a dark viscous liquid, which is diluted with four volumes or more of water to one of stock solution before application to the stumps.

The technique¹ of poisoning stumps with arsenite is outlined as follows. All sprouts are first knocked off at the crown with an axe or brush hook. The soil or duff immediately around the stump is removed with a light mattock or shovel in order to expose all budding tissue. Live oaks have large radial roots at a depth of four to five inches which should be exposed by this operation. The stump is then completely girdled by hacking through the bark at or slightly below ground level. A light weight axe is used for this operation and the chip is allowed to remain in place to catch and retain the poison. At the same time any exposed large roots are lightly hacked or barked. Girdling of the stump is quite the most important step in the whole operation; unless it is well done the results will be unsatisfactory. A small quantity of sodium arsenite solution is next applied to the cuts around the stump by manipulation of a stream of the liquid from the nozzle of a portable sprayer. The final step is to replace sufficient soil to cover the girdle, as a precautionary measure to conceal the poison from grazing animals.

An attempt was made to determine the influence of concentration of arsenite upon its efficacy as a stump poison by using

different volume dilutions of the stock arsenite solution (50 per cent As_2O_3 by weight) with water. They ranged from (4:3) to (1:50). The most dilute solution, therefore, contained about 1.4 per cent As_2O_3 and this was found quite as potent as the greater concentrations. The latter, on the other hand, were none the less effective because of their higher viscosity. Arsenic apparently is such a potent poison that even when the stock solution of sodium arsenite is diluted with 50 times its volume of water, the diminished toxicity is less a factor than proper preparation of the stump.

The main disadvantage of sodium arsenite is the poison hazard to animals. Domestic cattle seem peculiarly attracted to alkali arsenites and there must be no chance for them to lick the poison. Hence, all girdles must be covered after treatment, and all solution inadvertently spilled must be buried beyond reach. Experience has shown, however, that widespread use of soluble arsenites in a grazing area can be expected to lead to the death of some cattle. The poison hazard to workmen applying the solution must also be considered. For these reasons, despite the cheapness and efficiency of sodium arsenite, other herbicides were sought for in this investigation.

A cheap grade of common salt was one chemical used. When piled in sufficient quantity around oak stumps it proved to be a reasonably capable killing agent. However, 15 to 50 or more pounds, depending upon size, was necessary to kill a stump completely. Lighter applications, although they reduced the vigor of a stump, did not ordinarily prevent all sprouting. The large amount needed involves too great an outlay for labor and

¹Two mimeographed pamphlets have been prepared by the California Forest and Range Experiment Station for the use of forest camp superintendents and foremen, entitled, "Instructions in the Use of Sodium Arsenite in Killing Sprouting Stumps on Firebreaks," and "Instructions in the Use of Diesel Oil in Killing Sprouting Stumps on California Firebreaks."

transportation to encourage the use of salt in mountainous country.

Sodium chlorate, applied in the manner described for sodium arsenite, was highly successful. Its widespread use has not been recommended because of its relatively high cost and because this compound under certain conditions is unstable and has been known to be the cause of spontaneous combustion.

Arsenic acid (H_3AsO_4) proved to be a potent stump poison. Presumably arsenic in this acid form would be less attractive to animals than in the form of a salt like sodium arsenite, but no definite information on the relative poison hazard is at hand. Arsenic acid is neither as readily available nor as inexpensive as sodium arsenite.

Ammonium thiocyanate also proved a satisfactory stump poison. It is not considered to be particularly toxic to animals but its high cost precludes its competition with cheaper chemicals of equal or greater effectiveness.

Of the various substances investigated, a particular grade of petroleum oil, testing between 27° and 29° API, proved in several respects the most desirable. This is a grade commonly used in transportation Diesel engines. It was uniformly successful when applied correctly, practically all failures being traceable to inadequate stump preparation. The oil does not have the undesirable characteristics found in the arsenite and chlorate. It can be purchased relatively inexpensively from local petroleum supply depots, and altogether gives a desirable mean between high toxicity, low volatility, and cheapness. For these reasons the use of this Diesel oil² for killing sprouting stumps was investigated extensively.

Heavier fuel oils for domestic furnaces and industrial burners are usually still residues or cut-backs and contain much asphalt and other ingredients of little or no specific killing power when applied to vegetation. Stove oil, kerosene, and the more refined oils for motor usage are either too volatile or too deficient in herbicidal ingredients to be suitable. As shown in Table 1, the success of a commercial Diesel oil of 32.8° API was only 20 per cent.

It is generally believed that oils owe their killing properties to oxygenated bodies such as the carboxylic acids and to unsaturated hydrocarbons, distinguished by their ability to react with sulfuric acid. Diesel oil of 27° API gravity may contain 40 to 50 per cent of unsaturated compounds. This is a higher percentage than is held by the more highly refined oils. The gravity number is admittedly an incomplete specification for the herbicidal value of petroleum oil but it supplies a convenient designation by which commercial grades of oils can be distinguished and empirically tested.

In treating stumps with Diesel oil, all sprouts are broken off with an axe or brush hook. This is followed by the removal of the duff and dirt from around the stump to expose the sprouting tissue; then the stump is hacked with the axe all around the area below and at the former ground line. Finally the oil is applied as a fine spray from a portable pressure sprayer. The entire surface of the stump is completely wetted with the oil twice to assure absorption of sufficient quantity of oil. Oil is not readily transported by plants; it kills the tissue only locally near the point of application. For this reason the hacking and wetting must be thorough. Stumps should

²Recent developments in oil refining practice in California have resulted in changing the gravity of "Diesel oil" from 27° to 31°-34° API. While such a change results in more desirable fuels for Diesel engines, these higher gravity oils have much lower herbicidal value. These oils may still be marketed under the designation "27°-Diesel oil" but for plant poisoning they will be disappointing unless the gravity falls between 27° and 29° API.

not be covered after application but left exposed to air and light to encourage oxidation of the unsaturated compounds.

Six to eight stumps of average size can usually be treated with one gallon of oil. The average workman can treat from five to eight stumps per hour. Because of the ease of application, the high degree of effectiveness, and the lack of hazard, Diesel oil has been adopted for killing stumps on California firebreaks. The cost of sodium arsenite per stump is less, but inasmuch as labor forms the principal expense, this price difference is of minor importance.

The use of poison is highly recommended over methods of grubbing and of blasting formerly used. Even moderately large stumps may require as much as one-half man day to grub. Where stumps are blown out with explosives, the cost for powder alone will average as much as 25 cents or more per stump. When the purpose is not to remove but simply to kill the stump, the use of poison accomplishes this result with a significant saving of time and money.

An important question is the influence of the season upon the resistance or susceptibility of the plants to poison. Only with Diesel oil and sodium arsenite were stumps treated every month of the year. In neither case were there significant variations in success with time of the year. Under California conditions, at least, treatment in one season is apparently as good as in another.

A comparison of the size of the stump and the probability of killing it with poisonous chemicals is of interest. Table 2 presents results for Diesel oil treatment only, but is comparable to data obtained with soluble arsenite.

Table 2 shows that the success of the treatment falls off greatly when the stumps exceed 25 inches in diameter. This is because the larger stumps are more irregular and more difficult to pre-

pare. The figures in the second column are the percentages of stumps killed by a single application. "Forty per cent" means that only 40 out of a hundred stumps treated were completely killed by the first application. It does not mean that the treatment was only 40 per cent effective. Actually, the effectiveness was much greater than this, as those stumps not completely killed were reduced from a large bush of many branches to a small bush with, perhaps, only one or two sprouts. Accordingly, a second application to stumps of the 36-40 inch size group could be expected to kill, not another 40 per cent of those treated but 98 per cent, since the stump has been reduced to the 1-5 size group.

In order to get an idea as to relative susceptibility to poisoning of certain common sprouting species, all stumps treated with sodium arsenite, sodium chlorate, and Diesel oil were grouped together for the data of Table 3.

Certainly all the species of Table 3 are susceptible to poisoning by the chemicals employed, if the latter be properly applied so as to reach all the important tissue of the plant. The differences in the "Percentage killed" probably represent not so much a specific difference in susceptibility as a difference in the ease with which the chemical can be applied to the plant tissue. Live oak stumps are often large and irregular, and cannot be

TABLE 2
COMPARISON OF SIZE OF STUMP AND EFFECTIVENESS
OF TREATMENT WITH 27° DIESEL OIL

Average stump diameter in inches	Percentage killed with Diesel oil
1-5	98
6-10	99
11-15	90
16-20	93
21-25	87
26-30	62
31-35	56
36-40	40
41-45	25

treated as easily as the smaller plants of other species.

SOIL STERILIZATION

Experimentation on sterilization of soil was carried out with the idea that, if an economical and adequate method of soil sterilization should be developed, it would find application in preventing plant growth on a narrow strip of soil to be used as a backfiring lane along one or both edges of the firebreak.

Following the initial clearing of a firebreak there invariably occurs a stimulated growth of annual grasses, wild grains, and weeds. These plants are objectionable inasmuch as they are dry and inflammable during the fire season. Where a truck trail forms an integral part of the firebreak, the dry annual vegetation is not so serious since backfiring can be performed against a clean motorway. Where the break is separate from the road, however, combustible cover on the firebreak precludes backfiring until a narrow fire trail has been cleared by hand. Such work consumes time, and any delay impairs the strategic use of the break.

Tables 4 and 5 summarize the results of using certain chemicals in sterilizing the soil against grasses and bear clover, two principal offenders in the problem of firebreak maintenance in California, and typical respectively of shallow-rooted annuals and deep-rooted perennials. The results were judged by visual observa-

tion and estimation (within 10 per cent) of the extent of full cover kept from growing by the presence of the chemical in the soil. This estimation was facilitated by comparison with adjacent untreated plots. The tables present averages of three similar plots located in different parts of the Sierra foothill region.

The sodium chlorate was applied both as a dry powder and dissolved in water, with similar results in both cases. Sodium arsenite was applied as a solute approximately of the composition NaH_2AsO_3 . Arsenic trioxide and borax were spread as dry powders.

When soluble arsenites are sprayed upon the ground, they rapidly become "fixed" either by colloidal absorption or by chemical precipitation, so that they remain in the thin top layer of soil. Consequently they are admirably suited for killing grass roots and for preventing the sprouting of seeds. Table 4 shows that as little as 1 or 2 pounds per square rod of sodium arsenite rendered the soil practically free from grassy growth. Deep roots, on the contrary, will be below the arsenic poisoned layer and will be uninjured. Thus the data in Table 5 show that up to quite large concentrations of arsenic, the bear clover was little harmed.

Chlorates are very soluble compounds and are not precipitated or strongly absorbed by colloidal constituents of soil and consequently act differently. They penetrate the soil readily, reaching and killing deep-rooted perennial plants. For the same reason they are easily leached from the top soil and are not long present to deter the growth of grasses and other shallow-rooted plants.

In making these soil sterilization tests, the ground cover was removed and the chemical solutions sprayed on the bare soil surface. The arsenite was not very destructive to bear clover when applied in this manner. In other plots sodium

TABLE 3

EFFECTIVENESS OF SODIUM ARSENITE, SODIUM CHLORATE, AND DIESEL OIL IN KILLING VARIOUS SPECIES OF STUMPS

Species	Percentage killed
Live oak (<i>Quercus wislizenii</i>)	87
Black oak (<i>Q. kelloggii</i>)	95
Coffee berry (<i>Rhamnus californica</i>)	97
Rhamnus (<i>Rhamnus ilicifolia</i>)	99
Mountain mahogany (<i>Cercocarpus betuloides</i>)	100

arsenite solution was sprayed directly on bear clover foliage at a season when the soil was quite dry, and in these cases the poison apparently entered the leaf tissue and was translocated even to the roots so that all portions of the plant were killed. The chlorate seems to kill not so much by foliage contact as by soaking down through the soil to come in contact with the roots.

Arsenic in the form of arsenic acid solution was tried on grass and bear clover, by spraying foliage in the dry time of the year. Effectiveness against grass after the first season, for spreading rates of 1, 4, and 6 pounds of H_3AsO_4 per square rod, were, respectively, 50, 90, and 100 per cent; against bear clover, for the same rates, 63, 90, and 100 per

cent. The "grass" data are comparable with analogous figures in Table 4; the latter figures must not be compared with Table 5, since the methods of treatment are not the same. Roughly, it required about six pounds of H_3AsO_4 to do what four pounds of As_2O_3 in the form of NaH_2AsO_3 would do. For the same arsenic content, however, the two compounds seemed to have nearly equal herbicidal value. Arsenic acid is of interest in this connection, since it is possible that, being an acid and not a salt, investigation might prove it to have none of the attraction of sodium arsenite for grazing animals.

Borax, like chlorate, was found to do little harm to grasses and small broad-leaved herbs, but to be somewhat dele-

TABLE 4
EFFECTIVENESS OF VARIOUS POISONS APPLIED TO SOIL AGAINST GRASSES

	After season	Pounds per square rod						
		1	2	3	4	6	9	12
Sodium chlorate	1st	0	10	25	40	70	95	100
	2d	0	2	7	20	40	88	98
	3d	0	0	0	2	6	25	30
	4th	0	0	0	0	2	10	16
Sodium arsenite ¹	1st	90	90	90	95	95	100	100
	2d	88	90	92	94	97	100	100
	3d	91	92	92	93	97	100	100
	4th	80	84	87	89	95	100	100
Arsenic trioxide	1st	10	25	45	50	70	80	90
	2d	68	80	85	88	92	95	97
	3d	---	---	---	97	97	97	97
	4th	---	---	---	90	92	96	97
Borax	1st	0	0	0	0	0	0	0
	2d	0	0	0	0	0	0	0
	3d	0	0	0	0	0	0	0
	After season	Pounds per square rod						
		4+1	4+2	4+3	4+4	6+1	6+2	8+1 8+2
Arsenic trioxide + Sodium chlorate	1st	50	60	70	80	70	70	80 80
	2d	90	93	96	96	97	97	99 99
	3d	97	97	97	98	98	98	100 100
	4th	93	95	95	97	98	98	100 100
Arsenic trioxide + borax	1st	50	50	50	50	70	70	75 75
	2d	88	88	88	88	95	95	97 97
	3d	92	92	92	96	97	97	98 98
	4th	90	90	90	90	95	96	98 98
Sodium arsenite ¹ + Sodium chlorate	1st	100	100	100	100	100	100	100 100
	2d	99	100	100	100	100	100	100 100
	3d	97	97	98	98	98	98	100 100
	4th	85	87	92	93	97	97	100 100

¹Pounds of As_2O_3 in the form of NaH_2AsO_3 .

terious to bear clover. It takes more borax than chlorate to kill bear clover and the borax seems to be slower acting.

The boron minerals Kramerite and Colemanite were tried at spreading rates of from 2 to 16 pounds per square rod. Kramerite, like borax, did not keep grasses out of the plots even during the first season, while the second season showed a positive stimulation of grass growth. Where 12 to 16 pounds of borax or Kramer ore had been used on bear clover vegetation there was little or no bear clover left alive, but in its stead a full stand of tall dense native grass. Equal amounts of Colemanite likewise killed the bear clover and in addition prevented the establishment of any considerable grass cover through three seasons.

If sodium chloride is applied at the rate of 70 pounds or more per square rod, the bear clover is almost entirely eradicated. The kill is more certain on level than on sloping ground. Grass also is killed for the first season, but thereafter it springs up as abundantly as ever.

Treatment in the fall of the year proved most successful in sterilizing soil with chemicals. Arsenic trioxide is slow acting and when applied dry should be given time to dissolve and diffuse before the spring growing season. Sodium chlorate needs the benefit of the winter rains to permit absorption of the poison by deep roots. With chlorates there is always the potential danger of spontaneous combustion so that it should not be used in the heat of the summer when strong sunlight and high temperatures render such dan-

TABLE 5
EFFECTIVENESS OF VARIOUS POISONS APPLIED TO SOIL AGAINST BEAR CLOVER

	After season	Pounds per square rod							
		1	2	3	4	6	9	12	16
Sodium chlorate	1st	50	85	95	100	100	100	100	100
	2d	37	78	94	97	99	100	100	100
	3d	30	67	90	95	99	100	100	100
	4th	30	66	87	92	94	98	100	100
Sodium arsenite ¹	1st	30	60	75	85	90	95	98	100
	2d	10	26	39	49	73	83	94	100
	3d	0	25	35	43	67	78	92	100
	4th	0	0	13	17	43	58	87	100
Arsenic trioxide	1st	0	0	0	0	5	10	15	100
	2d	0	0	0	0	5	12	15	100
	3d	0	0	0	0	3	7	7	100
	4th	0	0	0	0	0	0	0	100
Borax	1st	0	0	5	15	65	80	100	100
	2d	0	0	5	15	65	80	100	100
	3d	0	0	10	30	60	75	100	100

	After season	Pounds per square rod							
		4+1	4+2	4+3	4+4	6+1	6+2	8+1	8+2
Arsenic trioxide +	1st	50	85	95	100	60	85	65	85
	2d	31	75	90	100	40	74	60	86
Sodium chlorate	3d	30	65	80	93	37	70	56	81
	4th	30	60	75	90	30	65	50	80
Arsenic trioxide +	1st	15	45	60	65	25	50	35	60
	2d	15	43	60	65	25	47	35	60
borax	3d	12	30	47	63	18	47	33	55
	4th	0	7	30	48	8	33	30	43
Sodium arsenite ¹ +	1st	90	95	100	100	100	100	100	100
	2d	85	95	99	100	98	98	100	100
Sodium chlorate	3d	80	90	95	97	90	95	100	100
	4th	67	80	93	95	83	90	93	95

¹Pounds of As_2O_3 in the form of NaH_2AsO_3 .

ger imminent. Sodium arsenite used as a foliage spray functions against the plant as a whole only when the soil is sufficiently dry to induce translocation from the leaf to the root. At other times it will kill the foliage but will not deter new growth from the roots. Accordingly, if sodium arsenite be used to eradicate bear clover, it should be sprayed on the foliage just previous to the winter rainy season.

Reseeding of bear clover has not taken place to any noticeable extent on the treated plots in the several seasons covered by this investigation. Neither has encroachment by root extension occurred from adjacent untreated bear clover plots.

These soil sterilization plot tests are now four years old. Observations will be continued to determine the length of time that a single application will maintain the soil in sterile condition.

It will have been noticed in the above presentation of experimental findings that arsenic in one form or another was highly effective both for killing stumps and for sterilizing soil. Nevertheless, in view of the hazard attending its use to both men and animals, the California Forest and Range Experiment Station is not yet recommending the widespread use of arsenic for any purpose.

CONCLUSIONS

It may be concluded from the stump

poisoning experiments that sprouting oak stumps can be killed by sodium chlorate, sodium arsenite, or 27° Diesel oil. A kill in excess of 85 per cent may be expected following the application of any one of these three substances.

Results of the experiments in soil sterilization yield the following conclusions: (a) Arsenic in the form of either sodium arsenite or arsenic trioxide distributed on soil to the extent of 4 or more pounds per square rod will effectually sterilize against grasses and shallow-rooted herbs but will not kill deep-rooted perennials; (b) sodium chlorate to the extent of 4 or more pounds per square rod will eradicate bear clover but will not eliminate the grasses; (c) borax to the extent of 12 pounds or more per square rod will kill bear clover but not grass; and (d) sodium arsenite, in 4 to 2 admixture with sodium chlorate applied in quantity of 6 pounds per square rod, makes a very serviceable soil sterilant for most of vegetation, with the exception of the trees, shrubs, poison oak, and bracken fern found on the California firebreaks.

We are pleased to acknowledge the valuable advice and cooperation received in this work from Drs. W. W. Robbins and A. S. Crafts of the Department of Botany, University of California, Davis, and from H. R. Offord, Bureau of Entomology and Plant Quarantine, Berkeley, Calif.



BRIEFER ARTICLES AND NOTES



THE INDIANAPOLIS MEETING OF THE A.A.A.S.

The Indianapolis meeting of the American Association for the Advancement of Science held December 27, 1937 to January 1, 1938 proved an overflow meeting, the registered attendance being slightly over 3,000 and the estimated actual attendance something in the neighborhood of 5,000.

The program as usual included a considerable number of sessions of particular interest to foresters, the most important of these being joint sessions of the Ecological Society and the Society of American Foresters held Tuesday afternoon, December 28. Dr. C. F. Korstian presided. Nine papers were presented at this meeting covering a wide variety of topics.

Papers at numerous other sessions, particularly those of the Ecological Society and the various sections of the Botanical Society, also held considerable interest to foresters. One paper on tree physiology which attracted a great deal of general scientific comment and was awarded the Association prize of \$1,000 for outstanding merit, was given by Dr. P. R. White of the Rockefeller Foundation, Princeton, N. J., who reported to the physiological section of the Botanical Society of America that he had found root pressures in plants large enough to account for the ascent of sap to great heights, ample enough to account for water conduction throughout the entire height of mature trees. This finding controverts a large amount of previous work which indicated that root pressures were not sufficient to transport water to great heights in tree stems, work which lent a great deal of

support to the cohesion theory at present widely accepted as the best explanation for sap rise in woody stems. White's paper accordingly may have a far-reaching effect on our understanding of one of the most fundamental problems in tree physiology.

Other papers of interest were those included in a seminar on growth-promoting substances, including papers by Hitchcock and Zimmerman and other leaders in this particular field; and papers on forest pathology, tree nutrition, and similar topics found scattered through numerous other sessions.

The general sessions of the Association seemed particularly interesting this year. One of the outstanding features was the beginning of a proposed five-year symposium on "Science and Society." This symposium, key-noted by the address of the retiring President, Dr. Edwin G. Conklin, on "Science and Ethics," attracted a great deal of general attention including considerable newspaper comment. It marks what may prove to be a very important current movement among scientists in shifting emphasis from science for science's sake to science for the sake of humanity. One of the papers on this year's program, presented by Gove Hambidge of the U. S. Department of Agriculture, dealt with agriculture and forest resources. The election of Dr. Wesley Clair Mitchell as President of the Association was apparently regarded by many members of the Council as particularly appropriate in view of increasing scientific interest in social and economic problems because of Mitchell's interest and familiarity with current social and economic problems imposed on a broad experience in education and in participa-

tion in public affairs. Mitchell is the second president in the history of the Association chosen from the field of the social and economic sciences, his predecessor being Doctor Carroll D. Wright, President of the Association about 35 years ago.

One of the outstanding general addresses was the Sigma Xi address of Doctor Irving Langmuir of the Research Department of the General Electric Company, who spoke on biological applications of surface chemistry. Langmuir's address was notable for the simplicity with which he described his experiments in this field, experiments which promise to supply procedures of unusual interest in exploring the nature of metabolic processes in living organisms.

Dr. C. F. Korstian and the writer attended all meetings of the Council of the A.A.A.S. as representatives of the Society, the writer acting as alternate for Dr. Henry I. Baldwin. A large part of the Council sessions were occupied with matters of routine nature. One item of special interest to foresters was the enthusiastic adoption of the resolution given below in which the Association reaffirmed its position on the status of the federal land utilization agencies in the light of possible governmental reorganization:

Resolved, that the American Association for the Advancement of Science reaffirm its position on the status of federal land utilization agencies as expressed in the resolution adopted at its Pittsburgh meeting in December, 1934; namely:

That any reorganization of United States government agencies should provide for the continuance in the Department of Agriculture of the land utilization agencies now there, including the Bureau of Agricultural Economics, Bureau of Chemistry and Soils, Soil Conservation Service, Forest Service, Bureau of Biological Survey, and the addition of other agencies concerned with renewable resources, such as the agricultural, forest

or range use of the public domain or the protection thereof from erosion.

Be it further resolved, that all positions in these Bureaus should be retained under the existing Classified Civil Service without exception because of their policy-determining nature.

Your representatives also attended a meeting of the Council of the Union of Biological Societies. The item of principal interest at this meeting was a discussion of proposed plans for the continuation and refinancing of *Biological Abstracts*. The Committee on Arrangements appointed by the Union had previously worked out a method of supporting *Biological Abstracts* involving a sliding subscription scale for universities and other subscribing units based upon the number of biologists at such institutions or units. In some cases this would have involved a master subscription price of up to \$200 although individual subscriptions under these master subscriptions would have been at a \$7 rate. This procedure had been objected to by the Chairman of the Committee on Periodicals of the American Library Association who felt that a subsidy subscription plan of this character was undesirable and went on record as opposing it. As an alternative he proposed that *Biological Abstracts* be ultimately carried by widespread contributions from biologists themselves through the contribution by biological societies of two or three dollars per member toward the support of *Biological Abstracts*. The Library Committee agreed that if biologists would indicate their willingness to support *Biological Abstracts* by approving such a plan that they, the librarians, would approve of financing *Biological Abstracts* on the subsidy plan for up to two years until proper readjustment had been made.

Up to the date of writing no definite action has been taken with regard to the continuation of *Biological Abstracts* on any set plan. But it was evident at the

meeting of the Council of the Union in Indianapolis that many biological societies had serious objections to this procedure and felt that it would be impossible to carry out, particularly if this meant extra assessment of junior members or of special classes of members not directly interested in the type of abstracting service furnished by *Biological Abstracts*. This would certainly be the case with a society like our own where many men are interested chiefly in administrative and business aspects and are not particularly concerned with the botanical and biological material covered in *Biological Abstracts*. The Society of American Entomologists was the only organization at the meeting which definitely went on record as rejecting the alternative proposal of the Committee on Arrangements. But representatives of other societies, including your own, expressed themselves as opposed to such a plan or as having grave doubts as to its acceptance by their membership.

Accordingly, the exact status of *Biological Abstracts* is not known at the present time. Apparently no action will be taken until the general response and attitude of the Biological Societies is known. A number of men present at the Council meeting, however, indicated that they felt the action of the Library Committee was entirely unjustified, this action having been taken in most cases without reference to the biologists at the institutions concerned. These men indicated their feeling that if the biologists were consulted, and they should be, that they would favor the subsidy plan because of the great value of the journal to them. The Council went on record as resenting what it felt to be the unwarranted attitude of the Periodical Committee of the American Library Association.

Future meetings of the A.A.A.S. include a summer meeting in Ottawa, Canada, June 27 to July 2, 1938, and a winter meeting in Richmond, Va., December

27 to 31. Winter meetings to follow for the next two years are both in the eastern United States, the one for 1939-40 being planned for Columbus, Ohio, and that of the following year for Philadelphia, Pa.

I. T. HAIG,

U. S. Forest Service.



HOPKIN I. RICE
1879-1938

Hopkin I. Rice, a Junior member of the Society and District Forest Ranger of the Cache National Forest, passed away at Logan, Utah, February 15, as a result of a paralytic stroke suffered last December. With his death the U. S. Forest Service loses one of its most respected, valued, and beloved members.

Mr. Rice entered the Service during the early days of the conflict between the sheep and cattle interests. Many interesting tales were told of his resourcefulness and daring during those troubled times when gunfire was not uncommon. He was endowed with the frontier spirit in its truest sense. His special pride was bringing Logan Canyon back to its present coverage of timber and palatable range plants through good range and timber management and intensive fire protection.

Mr. Rice was born May 26, 1879, in Cache County, Utah. He had a common school education and took a short course in forestry designed for rangers at the Utah State Agricultural College. Through constant application and steady efforts he made remarkable progress in self-education.

Prior to entering the U. S. Forest Service he gained familiarity with grazing conditions through experience on the range caring for livestock and through ownership of a small ranch near Providence. He also had logging experience prior to entering the Service.

Mr. Rice entered the employ of the U. S. Forest Service as an Assistant For-

est Ranger July 15, 1908, and was employed during the summer months each year until October 1, 1911, at which time his position was made permanent and he was transferred to the Cache National Forest. He was promoted to the position of Forest Ranger on April 1, 1915. He spent most of his service in charge of the Logan District, with headquarters at Logan, Utah.

Mr. Rice was considered especially proficient in grazing administration and fire control. He was a practical man, and not only had good ideas on resource management but had sufficient energy and personality to put these ideas into effect in the field. He earned an enviable reputation as a fire control man while on detail to the Kaniksu National Forest in northern Idaho in 1926 and on the Boise National Forest in 1931. On these fire details he proved himself to be an excellent "fire boss" with great ability to handle men, sound judgment, initiative, and knowledge of fire suppression technique.

At the time of his death Mr. Rice had rounded out more than a quarter-century of faithful performance in the capacity of Forest Ranger, and was scheduled to retire from the Service at the age of 62 on May 26, 1938. He was a capable District Forest Ranger, and had many fine accomplishments on resource management to his credit.



DEMOCRACY AND THE MERIT SYSTEM

Having believed the Society of American Foresters sincere in its policy of non-partisanship in the civil service and in the Society, I experienced a feeling of shock upon reading the address delivered by the retiring president of the Society at the national meeting in December, 1937. The bitterness of the attack, obviously directed at the Minnesota progressives, the attempt to identify them with murderers, corruptionists, and gangsters without mentioning names, the political animus of

parts of the address, are remindful of political stand-patters in the heat of a political campaign. Actually, the "facts" cited (about Minnesota at least, and perhaps Louisiana, too) are taken from the political literature of the last few campaigns, long ago completely discredited and some of them shown through court action to be falsehoods.

In view of the Society's historical stand on political partisanship, it is indeed surprising that its president should have made so extremely partisan a speech.

It seems to me an appropriate time to bring some additional viewpoints to bear upon this question of the merit system and its relation to democratic government. As a starter, I will discuss the matter as I see it.

RECENT CHANGES IN MINNESOTA

First, I have felt, for various reasons, that a part of the Society may view the recent change of state foresters in Minnesota with suspicion, and, in view of the decided political color of the then president's December speech, I now suspect that there may even have been some hunting in closets and under the bed for evidence that my appointment to replace Grover Conzet is the first step in a patronage raid on the Minnesota Forest Service.

Since I happen to be the state forester appointed by the Minnesota progressive administration, I may even be regarded as the terrible example of the "spoils system" versus the "merit system," between which, according to the former president, there is no middle ground. May I be forgiven, therefore, if in parliamentary language, I rise to a point of personal honor and talk about myself and about Minnesota in relation to "merit" and to "spoils?"

The inference throughout the former president's discussion of this subject is that administrative removal of a competent technical man and his replacement by

another man, also technical and competent, fall just as completely within the "spoils" system as "political" removal of such a man and appointment of an incompetent non-technical "spoils" man in his place. To me there is a vast difference.

To begin with, I approved on the Minnesota scene after the decision to replace my predecessor had already been made by a new administrative head of the Conservation Department. When I voluntarily resigned from the U. S. Forest Service I had no thought of seeking the state forester's job and had no inkling of the impending change. I finally accepted the offer, but largely on my own conditions.

The ethical question involved, it seems to me, is whether a professional forester should ever enter state service to replace another professional forester who is being transferred to a less responsible position for administrative reasons, as in the Minnesota case. (This was the proposition put up to Grover Conzet but he chose to resign.)

PUBLIC LANDLORDS AND THE CIVIL SERVICE

It should become clear, moreover, that in times of political upheaval, administrative (as distinct from "political") replacement in major administrative and policy forming jobs is often necessary in order to insure teamwork in the administrative branch of government. I have in mind such positions as the heads of bureaus and divisions which are directly responsible for managing public resources, such as lands and forests. The responsibility of these positions is much greater than that of a mere technical agency. They carry the broad powers of landlordism, and everything which that means in terms of power over the lives of people.

Under political administrations controlled by the privileged few it is almost inevitable that public properties will be

managed primarily in the interest of those few. If a new political administration, interested more in human rights than in property rights, wants to manage the public properties in the interest of the many rather than the few, it may find this objective well nigh unattainable as long as the old-guard administrators stay in office, with their long-established contacts and friendship with the privileged classes. To place a taboo on their replacement would mean ossifying public service and making it irresponsive to the changing conditions of life.

In fact, administrative replacements are commonly made in federal bureaus which rigidly adhere to the "merit" principle. I believe it will be granted, therefore, that my acceptance of the position of state forester, in no sense violates that principle. I believe the U. S. Forest Service shares this view. I believe my predecessor will grant it also.

DO WE WANT AN "UNTOUCHABLE" CIVIL SERVICE?

Some may argue, however, that the importance of "public landlord" jobs is an additional reason why they should be protected by an iron wall against personnel changes at times of political change. The inference of this argument is that a politically inviolate civil service is better able to serve the people than one which is more subject to the will of the people, as expressed through their elected representatives. An honest appraisal of this viewpoint calls for a penetrating look at what we are seeking when we insist on the principle of merit in selecting and retaining public servants.

Presumably the objective of the merit system is to select the man who is technically, administratively, and otherwise the best available man for a given job. This, of course, is partly a matter of judgment. That brings up the question of whose judgment. Some will say it should be left entirely to technical examining

and selecting boards. This, I believe, is erroneous in one major respect, namely that the technical board may in no respects represent the people whom the selectees are to serve. The nearest thing to representation which those people have, is their elected representatives. So, after skilled examiners rate the candidates and produce a list of eligibles, should the elected representatives of the people not have a voice in selecting from the eligibles those men who are most in sympathy with the objectives and purposes of the people? This may sound like heresy. After all the gospel that has been preached about a politically inviolate civil service. But I was a part of such a civil service for ten years, and am not convinced that it is the answer to the people's prayer for good public service. It tends too much to create an entrenched bureaucracy, smug and sanctimonious in its freedom from political "taint." It is so sheltered from the main currents of the political and economic life of the people that sympathetic handling of the public business becomes impossible.

It may seem a dangerous proposal to suggest that the remedy for this is to give the elected representatives of the people a voice in selecting public servants (from those who are technically and administratively qualified as determined by technical examining boards). Yet, to me, it appears as one of the most effective measures needed to make democracy work, and to prevent the holding of administrative power by an "untouchable" bureaucracy obeying an ideology of its own, but largely transplanted from the sheltered cloisters of the schools and from the middle class homes of those who are financially able to attend school.

Back of the argument for an "untouchable" civil service, moreover, realists may detect a desire of the bureaucrat for security against the insecurities of a world in political and economic turmoil. We cannot quarrel with the desire for security,

although the more sporting choice is to seek it through helping to make the world (and not merely the civil service) secure.

MAKING CIVIL SERVICE RESPONSIVE TO THE PEOPLE

Basic to the belief that an inviolate civil service is best, whether for the public or merely for the bureaucrat, or for both, is distrust of politics. In our country this means distrust of democracy. Heaven knows, American politics has given sufficient reason for distrusting it, for our being discouraged, and for seeking security through alignment with one of the minority pressure groups, such as the civil service group. But, again realism says security cannot be found through the fierce competition of rival pressure groups. Democratic action of the whole of society for the whole of society, holds the only real hope that I can see.

I believe in democracy, but I cannot see that it has ever been tried out on a large scale. In the last five years we have made some slight progress toward a time when it can be tried out, toward a time when the people will be conscious of their political power and develop leaders who will not compromise with privilege.

Only by practicing democracy can we learn how to practice it. I have no illusions of great achievements in a short time. Viewing the mad rush of the world toward fascism and war, and considering the tight hold which privilege still has in America, and seeing our courts still more concerned with property than with human rights, are grounds for pessimism. But let us look with courage on the scene and align ourselves with democracy, even if it means some sacrifice of our personal security. As one part of trying out democracy, bureaucracy should be made responsive to the will of the people. Their elected representatives should have a voice in selecting eligibles from the lists of those who are found by examination

and record to be technically and administratively qualified for the job. I believe this can be done without violating the principles of "merit."

DO NOT MAKE "MERIT" A SHIBBOLETH

Of course, every decent American who believes in democracy must insist that its public servants should be efficient, competent, and animated with the spirit of public service. For the same reason he should root out, wherever he can, service based on the principle of "spoils." But let us not make a shibboleth of the term "merit system," as is done with "constitutionality," to obstruct the people's fight against entrenched interests. This already has been done too often. Moreover, let those who would preach the gospel of merit and non-partisanship in the civil service first wash their own hands of political mud-slinging.

ELLERY FOSTER,
Minnesota Forest Service.



COSTS INCREASE FOR CATTLE PRODUCTION ON DEPLETED RANGE

Experiments conducted since 1932 by the U. S. Forest Service and Bureau of Animal Industry at the U. S. Range Livestock Experiment Station near Miles City, Mont., show conclusively that overgrazing materially increases the cost of producing cattle, when compared with costs on range subjected to lighter use. It was further observed that overgrazing causes increased depreciation of breeding cows and reduces the calf crop.

The experimental area was divided into three sets of pastures. One was overgrazed about 25 per cent; one was moderately grazed, and one was lightly grazed, with about 25 per cent of even the choice forage remaining at the end of the season. Both summer and winter pastures was included.

In the beginning of the experiment 20

cows were placed in each of the three pastures. The average weight of the animals varied less than 8 pounds between lots. Within a short time the cows on the overgrazed pasture dropped an average of 40 pounds under the other two lots and at the end of the 1933 summer season the loss amounted to 90 pounds.

Uniform care was given the three lots and uniform bulls from the same sire were used. The average calf crop for two years was 75 per cent for the overgrazed, 97½ per cent for the moderately grazed, and 80 per cent for the lightly grazed pastures. Including the 1935 record the average crops for the three-year period were 70 per cent, 90 per cent, and 78 per cent respectively. The average two-year calf-weaning weights prorated to the total number of cows grazed were 197.6 pounds for the overgrazed, 278.1 pounds for the moderately grazed, and 239.6 pounds for the lightly grazed pastures.

Including the drought year when supplemental feed was required, the cost per pound of weaning calf weight was 1.4 cents for the overgrazed lot, or 57 per cent higher than the moderately grazed; and 37 per cent higher than the lightly grazed lot. Taking the drought year only the cost per pound was 8.5 cents for the overgrazed; 3.5 cents for the moderately grazed and 3.9 cents for the lightly grazed pastures. It is evident that more supplemental feed was needed for the first lot.



MANAGEMENT RESULTS OF THE PRUSSIAN STATE FOREST ADMINISTRATION

(Fiscal and Management Year 1935)

The 1935 report of the Prussian State Forest Administration, recently distributed in the United States, contains interesting reading for those American foresters who have been urging closer integration of game and forest management plans. It contains statistical information on the

number of forest-farm workers, who obtain part or all of their livelihood through employment in state forests, a function of public forests receiving increased attention in those parts of the United States where new National Forests are being established in cut-over regions. It also reveals that the actual cut now greatly exceeds the allowable cut as calculated by Prussian foresters in the long-time management plan—a situation suggestive of acute economic conditions, if not of political implications.

The Prussian state forests had a total acreage in 1935 of 2,505,504 hectares (1 hectare=2.471 acres) of which 243,000 hectares were classified as non-wood producing soil. The forests are divided into 28 administrative units. In addition to the state-owned forests, there were 1,208,531 hectares of privately owned or corporate forests which were under the technical supervision of the Prussian State Forest Administration.

Forest nurseries totalling 611 hectares in area were in operation during the management year 1935. This was more than 300 acres below the 1932 total and slightly in excess of the totals for 1933 and 1934. New plantations were established on 21,371 hectares, a substantial decrease, as indicated in a comparative tabular summary of planting activity, from the early post-war planting records.

Roads and trails totalling over 800 kilometers were constructed at a cost of approximately six and a quarter million Reich Marks, while an additional four and one-half million Reich Marks were spent on highway maintenance.

The total production of "Derbholz" (timber of over 7 centimeters diameter at the small end) subject to control—high, composite and low forest—amounted to 14,995,708 cubic meters, an excess of 6,127,188 cubic meters over the calculated allowable cut of 8,869,871 cubic meters. An additional 888,000 cubic meters of wood were removed in the form of stumpwood, twigs and small sticks. With a total of 2,261,695 hectares of wood-growing area, an average of 7.04 cubic meters of wood were cut per hectare. The total revenue from wood in the fiscal year 1935 amounted to R.M. 164,743,497.41.

The game report is of particular interest, in view of recent reports from Germany that in the struggle to gain more complete economic independence, game ranges are facing increased restriction. The following short paragraphs have been translated verbatim:

"The kill of red deer, fallow and roe shows, with the exception of fawns, the highest figures since 1924. The same applies to wild boar. The kill of badger amounted to several times that of former years.

TABLE I

MAXIMUM ALLOWANCE OF KILL AND MINIMUM KILL REQUIRED FOR REASONS OF GAME MANAGEMENT

Game animal	Classification	Maximum number of game animals that may be killed 1935-1936	Minimum number of game animals that must be killed 1935-1936
Red deer	Bucks (Including spike horns).....	4,363	3,283
	Does	6,512	3,895
	Fawns	3,372	1,944
	Total	14,274	9,122
Fallow deer	Bucks (Including spike horns).....	672	477
	Does	1,254	681
	Fawns	636	396
	Total	2,566	1,554
Roe deer	Bucks	11,006	7,584
	Does	13,417	7,315
	Fawns	6,263	3,674
	Total	30,686	18,573

"As far as hares are concerned the results were one third below that of the two previous years, and hardly reached the average of the last ten years.

TABLE 2
ACTUAL KILL OF GAME AND DEATH FROM NATURAL CAUSES IN THE HUNTING YEAR 1935-1936

Game animal	Classification	Killed	Death from natural causes
Elk (German moose)	Bulls	38	40
	Cows	32	40
	Calves	8	26
	Total	78	106
Red deer	Bucks	3,123	376
	Does	5,485	292
	Fawns (bucks)	1,180	75
	Fawns (does)	1,922	116
	Total	11,710	859
Fallow deer	Bucks	590	58
	Does	1,195	27
	Fawns (bucks)	203	10
	Fawns (does)	515	9
	Total	2,503	104
Roe deer	Bucks	10,584	1,292
	Does	11,274	1,642
	Fawns (bucks)	601	408
	Fawns (does)	4,420	555
	Total	26,879	3,897
Wild boar.....		6,054	332
Pheasants		1,433	20
Badger		200	18
Fox		4,890	29
Hares		39,392	225
Rabbits		10,654	5
Ducks and other small game		6,470	..

"Noteworthy is the fact that two wolves were also killed."

In Table 1 we find the approved *Abschussplan* (plan for official removal of game)¹ showing on the one hand the maximum allowance of the kill; and on the other hand the minimum kill required

for reasons of game management. The actual game killed by administrative action and the deaths from natural causes during the hunting year 1935-1936 is shown in Table 2.

The limits within which the kill in the state forests could proceed were not exceeded and the required minimum kill was reached except for a few red deer bucks.

The foregoing figures would be much more significant if they could be studied in connection with game census figures.

The total game revenue during the fiscal year 1935 amounted to R.M. 1,445,-395.36, nearly all of which came from the sale of game carcasses. Hunting privileges or licenses produced only R.M. 169,563.02. This amount is included in the above total.

A discussion of the status of the forest workers shows some interesting side lights on the social and economic possibilities of well organized and well managed forests. The forest workers are divided into the following classes:

Class	Number employed	Per cent
Forest laborers	18,874	27
Forest farmers	10,734	15
Forest farm workers	14,418	20
Construction men	12,325	17
Other skilled and unskilled laborers	10,553	15
Others	4,453	6
Total	71,357	100

The length of service of the men workers in 1935 was as follows:

Years of service	Permanently employed workers		Regularly employed workers			
	Number	Per cent	Men		Women	
up to 5	625	15	18,332	36	11,999	60
5 to 10	734	17	10,764	21	4,560	23
10 to 25	1,736	40	14,998	30	2,961	15
25 to 40	956	22	5,699	11	411	2
Over 40	290	7	927	2	57	0.3
Total	4,368	100	50,720	100	19,988	100

¹In the German forests the foresters, who are also game managers and protectors, enjoy most of the hunting privileges and they exercise them to comply with the demands of the principles of game management.

There obviously is a small turn-over of labor. Forest worker is apparently a life occupation.

A total of 35,594 workers are permanently and regularly employed and are rooted in their native soil. Of these 20,555 workers own and rent more than 4 acres, 10,758 workers own and rent less than 4 acres, and 2,272 workers own and rent homesteads.

The total wages paid to all forest workers in the fiscal year 1935 reached the total of R.M. 39,600,000, which was reported to be 4 per cent higher than for the previous year.

The following summary of the ledger for the year 1935 speaks for itself, mindful though we must be that current cut exceeded the calculated allowable cut:

Total gross revenue from all sources	R. M. 185,547,538.29
Total expenses for management	R. M. 128,101,806.06
Net revenue from Prussian State Forests	R. M. 57,445,732.23

H. T. J. CRAMER,

Wisconsin Conservation Department.



FENCE POSTS A MILLION-DOLLAR CROP IN MICHIGAN¹

The value of the annual cut of fence posts in Michigan is well over a million dollars, according to the Forest Survey which the Station has recently brought to a close in that state. To keep the 392,000 miles of farm, vineyard, and railroad fencing in good condition requires nearly 8½ million posts a year.

The following table gives the amounts of various wood species and of steel now in use and the estimated future requirements of the same materials. The variations between present and probable

future use are due in part to differences in durability and in part to changing customs.

Species	Posts in use		Annual replacements (est.)	
	Number	Per cent	Number	Per cent
White cedar	65,450,300	55.5	2,837,200	33.7
White oak	37,143,000	31.5	3,940,200	46.8
Aspen	445,000	0.4	345,200	4.1
Elm	487,300	0.4	244,200	2.9
Red oak	1,472,600	1.2	193,600	2.3
Tamarack	2,497,400	2.1	117,900	1.4
Misc. hardwoods	1,411,000	1.2	252,600	3.0
Misc. conifers	541,300	0.5	8,400	0.1
Steel	8,420,600	7.2	479,900	5.7
Total	117,868,500	100.0	8,419,200	100.0

Cedar has always been the favorite wood for posts in Michigan, but in recent years, due to a decrease in the supply as well as to the depression, farmers have been turning to other woods which could be cut on their own farms or nearby. As a result the use of oak has been increasing rapidly, and even such species as aspen, ash, and elm have come into common use.

About 23 per cent of the posts in use by the railroads are steel, and of all posts in the state, over 7 per cent are of this material. However, steel posts cost twice as much as cedar and their life is not much longer. This probably accounts for the fact that only 5.7 per cent of current replacement are of steel.

At 15 cents per post, the annual cut has a market value of \$1,190,895. Assuming that a man can produce about 50 posts per day, the woods work thus amounts to a total of 158,786 man-days, or a month's work for 6,350 men.

The annual harvest of this crop is therefore an important contribution of the forests to farmers and to woods workers in Michigan.

¹Technical note 127. Lake States Forest Experiment Station. Maintained by the U. S. Department of Agriculture in cooperation with the University of Minnesota.

THE INFLUENCE OF MYCORRHIZAE ON THE GROWTH OF SHORTLEAF PINE SEEDLINGS

In 1935 during the spring and summer germinating and growing period of shortleaf pine, it was observed at the U. S. Forest Service Nursery, Licking, Mo., that after a satisfactory germination stand, the pine seedlings growing in soil in which pine had not been growing the previous year remained dormant during the late spring and summer, while those growing in soil in which pine had been growing the previous season maintained a consistent rate of growth throughout the entire season. The seedlings growing in soil in which pine had grown the previous season developed tops and roots from 8 to 14 inches in length with well developed laterals. Those growing in soil in which pine had not grown the previous season grew until they reached about one inch in height and remained at this height until fall. New growth then started and continued normally. However, previous to

this second growth period the root systems were poorly developed and had few laterals.

The writer believes that these differences in growth were related to the presence or absence of mycorrhizae. In order to test this theory a careful study was made of three test plots. These plots were all located in an area which had been treated in the spring of 1937 with 2 cubic yards per acre of compost containing pine, hardwood litter and humus treated with commercial fertilizer. Plot 1 had been planted with shortleaf pine in 1935 and with cow peas in 1936. Plot 2 had been planted with shortleaf pine in 1935 and with hardwood species in 1936. Plot 3 had been planted with shortleaf pine in 1935 and with transplant shortleaf pine in 1936. On August 17th and on September 13th careful observations were made on top length, caliper measurement, average root length, number of lateral roots, and the presence or absence of mycorrhizae. In Table 1 is shown the growth of short-

TABLE 1
GROWTH OF SHORTLEAF PINE IN RELATION TO THE DEVELOPMENT OF MYCORRHIZAE

Plot 1 Shortleaf pine—cow pea—1-0 shortleaf pine			Plot 2 Shortleaf pine—hardwood—1-0 shortleaf pine			Plot 3 Shortleaf pine—shortleaf transplants—1-0 shortleaf pine		
No. of trees	August 17th observations		No. of trees	August 17th observations		No. of trees	August 17th observations	
	Length of top	Caliper		Length of top	Caliper		Length of top	Caliper
	<i>Inches</i>	<i>Inches</i>		<i>Inches</i>	<i>Inches</i>		<i>Inches</i>	<i>Inches</i>
27	1-1½	1/32	50	1-1½	1/32	10	2-2½	1/32
27	2-2½	1/16	10	2-2½	1/32	20	3-3½	1/16
9	3	3/32	1	3-3½	3/32	13	4-4½	3/32
Average root length 4 inches.			Average root length 4 inches.			17	5	3/32
No. of laterals 8-10, poorly developed. No mycorrhizae.			No. of laterals 10, poorly developed. Traces of mycorrhizae.			Average root length 5 inches. No. of laterals 10, well developed. Abundant mycorrhizae.		
			September 13th observations					
20	1-1½	1/32	47	1-1½	1/32	10	3	1/16
32	2-2½	1/16	12	2-2½	1/16	12	4	1/16
6	3	3/32	2	3½	3/32	13	5	3/32
5	4	3/32				12	6	3/32
Average root length 4 inches. Eight poorly developed but growing laterals.			Average root length 5 inches. Ten growing laterals with increased number of mycorrhizae.			8	7	1/8
						5	8	1/8
						Average root length 6-8 inches. No. of laterals 10-12, well developed. Abundant mycorrhizae.		

leaf pine in relation to the development of mycorrhizae on the three test plots.

The data in Table 1 indicate the lack of mycorrhizae on shortleaf pine following cowpeas and hardwoods and an abundance of firmly established mycorrhizae on shortleaf pine in plots where pine had been grown the previous year. This is characteristic of the entire area in which the three plots were selected. Shortleaf pine planted in the spring of 1937 in soils in which western yellow pine and 1-1 shortleaf pine had grown in 1936 showed a similar abundance of mycorrhizae and similar consistent growth throughout the entire spring and summer season of 1937.

In other tests new soil was inoculated with soil and roots taken from thriving shortleaf pine areas. These inoculated plots did not show an increased growth of shortleaf pine seedlings over those in check plots. However, these plots will be kept under observation and more definite results and distinct differences may still develop.

The writer believes that the mycorrhizal fungi must be present in old farm soil before 1-0 shortleaf pine can be grown satisfactorily. Pine transplants have a sufficient number of mycorrhizae to enable them to grow and thrive on old farm land. Soil can be inoculated easily in this manner.

The writer also believes that until organic material has been built up in old farm land to a point approaching natural forest conditions, mycorrhizal fungi have nothing to grow on during the fallow

year. Consequently their numbers are reduced to such an extent that the shortleaf pine has practically the same condition to contend with as in the original old farm soil. This condition is indicated in the shortleaf pine—cowpea—shortleaf pine succession in Plot 1. The September 13th observations of this plot showed that the seedlings were growing satisfactorily in spots a foot or more in diameter. These spots gradually enlarge as the mycorrhizal fungi spread and eventually encompass the entire bed. By the second year mycorrhizal fungi were firmly established and the pines grew normally.

These experiments indicate that a desirable planting succession is a soiling crop the first year, pine transplants the second year, 1-0 shortleaf pine the third year, etc. Many nurserymen have observed the conditions referred to in this article. While the facts presented at this time are not conclusive it is believed that their presentation will help solve some of the problems found in pine nurseries established on old farm land.

FRANK J. MILLER,
U. S. Forest Service.



ERRATUM

In Mr. L. W. Schatz's discussion of W. P. Good's paper, "Forestry Problems in the Paper Industry in the South," *Jour. For.* 36:187 (February), the average daily wage in the Pacific Coast Logging industry was given as \$5.80 instead of \$7.00.



REVIEWS



The Training of a Forester. By Gifford Pinchot. 129 pp. *Illus. J. B. Lippincott Co., Philadelphia, Pa. 1937.* Price \$2.

This, the fourth edition of a work first published nearly twenty-five years ago, probably has influenced more American foresters in their choice of a career than any other book. It is one of those rare literary productions that are as practical as they are readable. Mr. Pinchot was assisted in making the present revision—"bringing the book into tune with the times"—by Prof. Robert P. Holdsworth of Massachusetts State College.

Written in 1914, when forestry in America was still an infant, but already a lusty, profession, the book was intended principally as a guide for young men (and their parents) who were considering forestry as a professional career. If the importance of forestry and the need for well-trained foresters were of great national significance then, how much more so have they become today!

Its keynote, if it can be said to have one, is in the author's introduction to the first edition, "I urge no man to make forestry his profession, but rather to keep away from it if he can." But in the present edition, as in that early one, in nine fascinating chapters he proceeds to build up such an engaging case for a forester's life that the young man would be rare indeed who did not succumb to Mr. Pinchot's own evident enthusiasm for forestry. In all fairness to his intention, however, it must be admitted that he constantly emphasizes the importance of obtaining sound scholastic training, the stiff competitive examinations ahead of those

who would enter government service, the necessity of the forester frequently to do hard physical and mental work, and the fact that salaries generally are not high.

In a nutshell, the book satisfactorily answers the three questions most often in the mind of the prospective student of forestry: "What is a forest? What is forestry? What is a forester?" But it does more than that. It answers innumerable questions about what a forester does, what he must be, what he must know, where he works, and what he can expect in the way of compensation, promotion, happiness, and self-satisfaction.

Illustrated with 13 full-page photographs, and two end maps of the National Forests and the forest regions, the volume is legibly printed and nicely bound. Excellent though it is, it would be improved by an index.

HENRY E. CLEPPER.



Diminishing Returns and Planned

Economy. By George M. Peterson. xii + 245 pp. 2 pl. 16 figs. *The Ronald Press Co., New York. 1937.* Price \$3.

This volume includes two types of subject matter: (1) The "pure theory" aspects of diminishing returns, and (2) speculation or "philosophizing" about economic planning. The two are not integrated as fully as the author evidently wishes, nor, indeed, as fully as the title suggests. A better understanding of the principle of diminishing returns serves to place in bolder relief certain of the technical problems that a planned economy

must face, but Professor Peterson does not get beyond the flirtation stage with most of these problems.

The principle of diminishing returns is investigated along the lines followed by F. M. Taylor, but Peterson's analysis is more complete and more precise, and he skillfully clears the "fixed factor" barrier before which Taylor faltered. The digressions into the fields of marginal utility and interest theory seem unfortunate to the reviewer; the first suggests an indefensible mixing of psychic and physical phenomena, and the second strives to disinter the remains of Austrian interest theory. The theoretical offerings are generally sound and illuminating, however, and should be of much interest to economists.

The author believes strongly in the desirability—even inevitability—of economic planning, but he is highly critical of recent attempts at it in this country. "Practically every proposal advanced during the Roosevelt Administration in the name of economic planning or of a planned economy can be condemned on the ground that it is contrary to the law of diminishing returns" (p. 197). It appears that Peterson believes in planning if he can formulate the "plan"; that much, at least, he has in common with most other "planners"! His particular dragons are race-suicide and concentration of wealth resulting from private monopolies, and it is for their slaying that he urges the nation to plan. His concrete proposals for social action, numerous but not drastic, seem to be the lineal descendants of the "enlightened citizenship" and "courageous economic statesmanship" of former days. Commendable proposals, perhaps, but rather too thin a diet to satisfy the appetites of the more aggressive "planners" of today, particularly those who wish to extend the limits of planning far beyond the fields with which foresters are concerned.

Who is to plan? What is to be planned? For whom? How is a plan to be made effective without the use of force? (If all groups and all sections were in agreement, *any* planning would be superfluous.) If there is planning for one sector of the economy, can other sectors long remain unplanned? If force or coercion supplants market prices as the means whereby resources are allocated and apportioned, how ensure that "uneconomic" utilization of resources does not result? To questions such as these Peterson gives no answers, primarily because he fails to recognize the implications that inhere in any "planning" that goes beyond pious exhortations and social welfare work. Likewise he takes no account of the experiences with and consequences of planning in European totalitarian states.

Notwithstanding these deficiencies on the positive side, the book is studded with such sparkling passages as the following:

"The worst offenders against social welfare are not the entrepreneurs who profit, but those who lose. Society should do everything in its power to keep the factors of production out of the control of wasteful, incompetent managers. Their self-elimination, through financial failure, leads to slow social progress, and may result in aroused sympathies and an appeal for the government to refinance and resettle them—so that they may persist in their inefficiencies. A planned economy cannot be based upon sympathy; it must rest upon sound fundamental economic principles." (p. 160.)

Few persons will agree with all of the book, but no careful reader will fail to be stimulated by it. It deserves a place on the "must" list of the expanding group of foresters who are keenly and necessarily concerned with the problems of land-use planning.

RICHARD W. NELSON,
U. S. Forest Service.

Knowing Your Trees. By G. H. Collingwood. 109 pp. *Illus. American Forestry Assoc., Washington, D. C. 1937. Price \$1. (cloth).*

The October 1932 issue of *American Forests* carried an anonymous illustrated article on yellow-poplar, or tuliptree (*Liriodendron tulipifera*); since that date a similar article on an outstanding timber species of the country has appeared almost every month in that excellent periodical. To my own and, I trow, the delight also of librarians and bibliographers, the published authorship of this series of papers changed, with the January 1937 issue, from anonymity to the name of George Harris Collingwood, distinguished forester of the American Forestry Association. The 50 papers published through the January 1938 issue—excepting only the Christmas 1933 article on Norway spruce—have now, with very slight editing, been assembled into a slim volume, 8½ x 11½ inches, bound in forest green, the front cover neatly embellished with a boxed redwood design. In the foreword, the author attributes the genesis of the articles and the resultant book to the “constant demand for information concerning the characteristic appearance of each tree as recorded by the camera, together with its botanical features, its uses and economic importance, the meaning of its scientific name and the many details that distinguish it from its fellows of forest and roadside.”

The book deals with 11 genera and 28 species of softwoods, and 15 genera and 22 species of hardwoods. Each write-up occupies, with its illustrations, two pages of text, and Mr. Collingwood is to be commended for his success in crowding a mass of detailed information into so small a compass. The publication is essentially a dendrology, as this reviewer understands the term, all the features, including the botany, being approached from the professional forester's angle. At

the same time, the style is so simple and readable and the material so interesting, that the book is bound to win wide popular favor. The reviewer does not recall another American tree book with the statistical data, such as stand in board feet and annual cut, which this volume presents. Interpolated are numerous intriguing little items which enhance the general reader's zest, e.g., in the bigtree write-up, the author adds: “With the rosy purple drops of big tree sap, John Muir wrote letters, and reported that the Indians drank it in the hope of gaining some mystical power.”

So admirable is this book that the reviewer blushes at his possible captiousness in recording a few minor criticisms; almost he hopes the recording angel will encore his act with Laurence Sterne's immortal, Tristram Shandy, and delete the record with a tear! It is apparent from the foreword that this volume is the first of an intended series. Would it not, therefore, have been better to have added an annunciatory “Part I”—or something of the sort—to the title page? Apparently a rough attempt has been made to arrange these tree essays in an Engler & Prantl, or botanical, sequence; should not, therefore, the job have been done more accurately? The Dalla Torre et Harms' numbers for the 11 coniferous genera represented run from 22 to 45; these softwoods, therefore, would be in perfect botanical arrangement if *Larix* (24) and *Picea* (26) were transposed; also *Thuja* (42) and *Libocedrus* (41). The 15 genera of dicotyledonous angiosperms are badly jumbled; they should (if the botanical arrangement is to be adhered to) start with the lowest number, 1881, *Juglans* (which actually is 5th in the list) and end with the highest number, 6420, *Fraxinus* (which is actually 3d from the finish). Collingwood has not slavishly adhered to Sudworth's Check List. It seems to this reviewer, however, that he has not selected the strongest cases for departure

from the *usus Sudworthianus* and, moreover, has followed rather than corrected Sudworth's errors. For example, Collingwood adopts the Check List name for Douglas fir (*Pseudotsuga taxifolia* (Lamb.) Britt.), which, although most of us like *taxifolia* as a name better than *mucronata*, does not have a leg to stand on, botanically. It is a queer thing that almost all American botanists (including the late Dr. Britton himself), except Messrs. Sargent and Sudworth, use Sudworth's own combination for Douglas fir, *P. mucronata* (Raf.) Sudw., whereas Sudworth himself, as stated, used Britton's combination. This "tit for tat" situation has always completely baffled this reviewer. Collingwood adopts the untenable Sargent, California, and National Park Service name for bigtree, *Sequoia gigantea* (Lindl.) Decaisne. I wish with all my heart that this appropriate name could stand, but it is a complete homonym and cannot be defended under either botanical Code. That chuckle-headed Dutchman, Endlicher, who founded the genus *Sequoia*, insisted on making two species out of redwood; when the leaves were a bit long and a bit blue he called redwood "*Sequoia gigantea* Endl.," and, alas, that sad botanical muff estops us from (legally) calling bigtree *Sequoia gigantea*.

I am sorry that Collingwood did not see fit to change the Check List authority for *Picea engelmanni* (based on *Abies engelmanni* Parry) from Engelm. to (Parry) Engelm. By the way, the original spelling of *engelmanni* is with only one *-i*. While, possibly, the "Engelm." alone can be defended on a technicality, yet it is patently a reflection on an illustrious botanist, the late Dr. Engelmann, to intimate that he named Engelmann spruce after himself. The author of *Abies concolor* is Lindley, rather than Parry. It was the son (rather than father) Michaux who first named and described *Quercus borealis*. Britton, rather than Sweet, is the author of the combina-

tion *Hicoria glabra* (Mill.) Britt. In passing, the fruiting spray picture in this pignut hickory write-up strongly suggests bitternut hickory (*Hicoria cordiformis*). The shaded part of the distribution map of chestnut probably does not extend quite as far southward as it should. Apparently chestnut once occurred, if it does not now, in western Florida, and Roland M. Harper indicates that it now occurs within 40 miles of the Florida border. Trinomial English names for *species* are always unfortunate and should be taboo, wherever possible. It is regrettable, therefore, that Collingwood has lengthened the English name for *Abies concolor* from the Check List and Standardized Plant Names "white fir" to "western white fir." Also, would it not be better to follow Standardized Plant Names principles and usage and spell bigtree and tuliptree solid rather than as two words? One wonders if the author considered the desirability of adopting the Standardized Plant Names name "Canada hemlock" for *Tsuga canadensis*, and the trade name "Pacific hemlock" for *Tsuga heterophylla*? Both names obviously merit careful consideration. But these comments all concern trifles, readily to be ironed out when Collingwood gets out the second edition of his (à là Catullus) "*lepidum novum libellum arido modo pumice expolitum*."

Despite the many excellencies of his text, I do not think Collingwood will be offended if I hazard the guess that his pictures will "steal the show!" They are really superb. I had thought those of Hough's Handbook were the last word in tree book pictures, but Collingwood's book now easily distances the field. Each tree species has, besides its distribution map, half-tones from photographs showing habit, flowering or fruiting spray (or both), bark detail, and, in some cases, twigs or other parts. With the deciduous species, both summer and winter aspects are shown. The book is a delight, and every possessor will eagerly await all its

fellows to come. The price is a benediction; one wonders how the Association can break even on it!

W. A. DAYTON,
U. S. Forest Service.



Practical British Forestry. By C. P. Ackers. 387 pp., *Illus.* Oxford University Press, New York. 1938. Price \$5.

Here is a book that can be read with profit by any forester, because it contains so much sound philosophy based on long experience and the style is most engaging. The author, who has been practicing forestry on his own estate for many years, has successfully faced the hard fact that his woodlands had to pay, so that he now has 30 acres of commercial nurseries, some 2,000 acres of commercially run forest stands, and a sawmill utilizing about 1,000 cubic feet of timber a week. In addition visits to Continental Europe, South Africa, the United States, and Canada have greatly broadened his outlook. Throughout the text the reader realizes that he is listening to the voice of experience.

Primarily written for foresters on British estates, a wide range of topics is covered. After an introductory chapter on forestry principles, there are chapters devoted to the silvicultural and technical characters of hardwoods and conifers, and in the latter American foresters will find much of interest about Pacific Coast trees now widely used in Britain. Other chapters deal with damage by the elements, vermin, and other pests; nursery work; planting and establishing; thinning and pruning; extraction, conversion, and sale of timber; sport and modern forestry; the future; and silviculture, minor forest produce, and miscellaneous. There is also a list of abbreviations and a glossary,

both helpful when reading other British publications on forestry.

The concluding sentences of the introduction are significant in showing that problems of land use in Great Britain and in the United States have much in common: "England has been built up by private enterprise, and English forests should be largely controlled by private enterprise too, under fair legislation backed up by a sympathetic government forestry service. Suggestions are already being made that the absorption of private forest land by the state will be necessary, that private forestry has proved a failure and must come to an end. Such a fatal step still seems a long way off, but it is a live danger if English landowners do not utilize their forest land properly and keep it in a state of greater productivity."

In the discussion of the relative merits of pure and mixed stands are the following lines, "It is very wise to follow nature, but it is not very easy to do so. As it is so very easy to manage pure crops of one species it has become the custom largely to establish them, but it is going against nature and it is probably in many cases bad forestry. It must not be taken for granted, however, that we cannot improve on nature; we can, and in many ways."

Again in discussing fungous and insect pests the sage observation is made that, "Given a careful study of practical forestry, woods, duly planted with healthy plants in suitable mixture on good ground, will go ahead, and continue to go ahead; then none of these pests really count. Pests will not spread seriously in mixture and seldom in healthy pure crops without leaving plenty of marketable and growing trees to the acre."

The section entitled, "Over-taxation ruins sound forestry," in which the author gives his viewpoint of conditions in the United States and Canada, and the section on working plans are particularly forceful. In fact the reviewer could go

on endlessly citing excerpts, but it is hoped that enough has been said to show that this volume is far more than just a treatise on the practice of forestry in Great Britain.

J. S. BOYCE,
Yale University.



Cooperative Quail Study Association.

Sixth Annual Report, 1936-37.

By Herbert L. Stoddard, Director.
*Sherwood Plantation, Thomasville,
Ga. 25 pp. 1938.*

This report contains two items of interest to foresters, especially those in public employment. The first is on the use of fire, studies of which on this experiment have been about completed.

"Each year's evidence serves but to further convince us of the necessity of ample late winter burning of the proper kind in the management of upland game on the southeastern pineland types.

"Because of the proven value and necessity of using properly controlled fire in game development and even to a certain extent for silvicultural purposes in the southeastern longleaf pine belt, we had hoped that the widespread and grossly misleading propaganda for general fire exclusion would die out. Now, however, we find it again flaring up due to the rapidly developing interest in the pine paper industry. It behooves those interested in quail development as well as in reasonable liberty in land handling to watch state legislatures closely. This due to the fact that a vociferous fire exclusion faction desires to finance their program through the appropriation of public tax monies. The controlled use of fire costs at least as much as total fire exclusion on a long time basis and if the landowners who use fire fail to watch their interests closely they may find themselves in the unenviable position of having to

pay the cost of their own program while being taxed for the other fellows' fire exclusion costs."

The other point refers to the advent of the paper mills as a factor in estate management. The replacement of longleaf pine with loblolly and "shortleaf" (slash?) pine over wide areas has produced stands much denser than the original forest and entirely unsuited to quail or hunting. If a market develops so that trees removed in thinnings can be sold for pulpwood, this outlet will enable the owners to restore the desired conditions for food production and make a profit at the same time.

It is interesting to note that the attempts to exterminate fire ants have succeeded only in scattering them in more numerous smaller colonies and the conclusion is drawn that quail losses at time of hatching, from this source, probably will always have to be reckoned with.

H. H. CHAPMAN.



Über eine neue Erkrankung der Tanne (*Abies alba* Mill.) und der Fichte (*Picea excelsa* [Lam.] Link.). (A new disease of fir and spruce.) By Ernst Gäumann and Otto Jaag. *Phytopathologische Zeitschr.* 10:1-16. Illus. 1937.

This paper warrants special notice, both because of the very unusual type of disease and because it bears on forest planting policy. A European and American bracket gill fungus, *Pleurotus mitis*, has attacked plantations of white fir (*Abies alba*) and Norway spruce, nearly 70 years of age, in two localities in Switzerland. The seed is believed to have been imported but the source is unknown; the firs appear to belong to a different race from that of the natural stands. The soil is heavy and moisture-retentive; elevation is between 900 and 1,100 meters;

exposure for the most part is west. The fungus attacks the bark usually near the base, and extends upward in long narrow streaks, killing the cambium and gradually penetrating the wood until a definite red heart rot develops. In a few years the trees present a lobed appearance, the trunk having continued to grow between the dead strips but without bridging across them. The leaders die and characteristic bushy crowns develop in consequence. Cultures made from the infected wood and from the sporophores on the bark of some of the trees yielded the same organism. Cultures from both sources artificially inoculated in shallow holes in trunks reproduced the symptoms of the disease in both hosts, more readily in fir than in spruce. Inoculations were also successful, though to a less degree, in white pine, but similar inoculations in Douglas fir and stone pine (*Pinus cembra*), as well as check wounds made in all five tree species without adding the fungus, produced no result. The fungus was found to have unusually low temperature preferences, with considerably less growth at 75° F. than at 70°. It is regarded as an unusually virulent strain of a fungus that is normally saprophytic. The possibility of predisposing factors in these stands is considered and hail and lightning injuries are regarded as improbable factors in the case. The authors conclude that the disease is one of artificial stands, connected with foreign origin of the seed and its lack of adaptation to the local site conditions. Although younger volunteer trees considered to be from local seed were in some cases equally diseased, this is explained by the authors as the result of the mass infection and building up in virulence of the fungus that was made possible by the presence of the susceptible planted trees. The areas covered by the disease are small and within a few miles of each other, and the infected trees are being destroyed.

The chief interest to the reviewer is in the addition which this makes to the cases already reported in which plantations from seed of distant or unknown origin have proven abnormally susceptible to attack by organisms that are of no importance in natural stands.

CARL HARTLEY,
*Division of Forest Pathology,
Bureau of Plant Industry,
U. S. Department of Agriculture.*



The Need for Woodland Improvement in Indiana. By T. E. Shaw and R. C. Brundage. *Purdue Univ. Agric. Exp. Sta. Extension Bull.* 221. 16 pp. 1937.

A 16-page bulletin may not be very impressive at first glance, but this small publication is a gem in the great mass of forestry literature. The only mistake the modest authors made is that they did not tell the method by which much of the basic data were secured. The fact remains, however, that the authors made a personal survey and spared neither automobile tires nor human energy over a period of several months in this painstaking study.

The large amount of field work and the preparation of a bulletin that presents the facts in a precise and readable form like this one is indeed commendable. The study is based on the conditions and needs of Dubois County, in southwestern Indiana. The inference is that similar accomplishments under the program recommended can be made in other counties with like conditions.

The stand, growth, and depletion of timber by types in Dubois County are given. The total wood drain of the county has been carefully worked out by species and the requirements of some of the important local industries are well shown. The authors are to be complimented in

giving due space and emphasis to the consuming industries, for forestry literature too frequently seems to avoid this important phase of the forestry problem. The concluding pages of the bulletin suggest a program of woods improvement. There are several good illustrations and charts which add to the make-up of this publication.

R. J. HOYLE,
N. Y. State College
of Forestry.



Water Utilization by Trees, With Special Reference to the Economic Forest Species of the North Temperate Zone. By Oran Raber. *U. S. Dept. Agric. Misc. Pub. 257, 97 pp. U. S. Govt. Printing Office, Washington, D. C. 1937. Price 15c.*

Raber has given a comprehensive and much needed review of the literature on the subject of water utilization by trees. The bibliography includes 249 titles and is one of the most complete lists ever assembled on this subject. Although the paper is primarily a review and compilation of the results of other workers, the author has included considerable explanation and interpretation which serve to weld the material into an understandable whole.

The sections dealing with the water losses and water consumption by trees and the adaptations of trees to dry conditions should be especially interesting to foresters. The material on the general use of water in trees and the absorption and storage of water may be of less practical value, but is of equal scientific importance. The reader should not approach this publication expecting to find answers to many of the problems of forest and tree utilization of water. In most cases,

as the author points out, the final answers are not yet available. Indeed, one of the most valuable functions of this paper is to show the need of and point the way for future research in this field. In this it is very successful.

The reviewer has been particularly interested in methods of measuring transpiration and would like to emphasize that phase of the paper. The four general methods given are: (1) determination of amount of water absorbed by the plant, (2) measurement of stomatal opening, (3) collection or determination of the water vapor transpired, and (4) determination of changes in weight of the plant due to loss of water. How the measurement of stomatal opening can give a measure of water loss is not explained. Under (3), there are three sub-headings: (a) collecting the moisture given off with a hygroscopic substance, (b) measuring change in humidity of the surrounding atmosphere with a hygrometer, and (c) using some sort of an "indicator" applied to the leaf. Another method which falls in this category has been omitted. This is based on the principle of water condensation from the air when the dew point is passed. Although not in general use it has possibilities and deserves consideration.

In discussing the collection of transpired water with a hygroscopic substance the author has introduced some confusion. He makes the following statement: "This method, however, has a very serious weakness, inasmuch as the transpiration necessarily occurs in a space with an abnormally low humidity." It is true that some workers, especially early ones, have placed the hygroscopic substance in a closed chamber with the leaves. This would result in an abnormally low humidity. In general, however, this method has been replaced by one described by Freeman.¹ In this method air is drawn

¹Freeman, G. F. A method for the quantitative determination of transpiration in plants. *Bot. Gaz.* 46: 118-129. 1908.

over the experimental leaves enclosed in a glass chamber and thence through a pipe or hose to the hygroscopic substance usually held in U tubes. A control gives the amount of water in normal air. Owing to the difficulty of pulling air over the leaves fast enough to prevent humidity from building up inside the chamber the weakness of the method lies in the presence of an abnormally high, rather than a low humidity.

The same misconception colors the further discussion of this principle of transpiration measurement. This is shown in the review of another method² based on the same principle as Freeman's but permitting the measurement of attached tree branches in the field. The humidity inside the chamber is not low, as stated by Raber, but slightly higher than normal. The objection is also made that transpiration of a tree based on any one of its twigs is not trustworthy. This, of course, is true, but obviously is not a necessary condition of this method of measuring transpiration as Raber seems to infer. Satisfactory results depend upon adequate and representative sampling over space and time.

Measuring the changes in humidity with a hygrometer is described by the author as much superior to the above method. His objection to it is that the leaves are in a closed container, thereby causing a constantly increasing humidity. Not only would the humidity increase but saturation would, in many cases, be reached in 2 or 3 minutes. However, if air is drawn by means of a pump through the container and over the leaves, one hygrometer being placed in the ingoing and another in the outgoing stream, the method is tenable. This, however, has another objection, namely, accuracy is inversely proportional to the quantity of air run through the system per unit time. The

more air that is passed over the leaves the more diluted is the moisture added by them. It can be shown mathematically that high accuracy is incompatible with sufficient air movement to prevent undue humidity increase within the transpiration chamber. Fair accuracy, however, can be obtained by this method.

"By far the best method is the direct determination of water loss by noting the change in weight of the plant." But after coming to this conclusion the paper goes on to show conclusively that transpiration measurements from detached parts of a plant are highly unreliable. As it is obviously impracticable to pot and weigh a tree (except a very small one) it seems apparent to the reviewer that one of the other methods must be used for work with trees.

LEON S. MINCKLER,
*Appalachian Forest
Experiment Station.*

In view of the nation-wide interest, not only in the agricultural regions but also in the industrial and urban centers, in an efficient utilization of water resources, and in view of the importance of timbered areas, Dr. Raber has presented this paper in response to the "decided need for a summary of present knowledge concerning the amounts of water utilized by our economic forest species and of the various problems associated with this utilization." This paper is a summation of the literature upon the subject; it is not a report of specific investigation. The author has organized an impressive amount of data into a logical and connected whole, resulting in a very readable manuscript presented in five major divisions: (a) Absorption of water by trees (5 pp.); (b) Storage of water in trees and water content of tissues (8 pp.); (c) Water losses of trees (43 pp.); (d) "Adaptations" of

²Minckler, L. S. A new method of measuring transpiration. *Jour. Forestry* 34: 36-39. 1936.

trees to dry conditions (16 pp.); and (e) Water consumption by trees (9 pp.). A bibliography of 249 references is given.

Soil moisture, listed as one of the environmental factors affecting transpiration, is considered somewhat briefly. A resumé is given of some potted tree transpiration studies (p. 50). Cognizance of the following phenomenon of soil physics casts serious question upon the significance of such studies: Addition of water to a mass of soil will result in a distribution of the water throughout the soil mass only if the quantity is sufficient to satisfy or exceed the water-holding capacity of the soil. For example, if water is added to a pot of soil at a moisture content of 8 per cent in such quantity as to raise the weight of the pot to that of a moisture content of 12 per cent, it will be found that the soil moisture content has not been raised to a uniform 12 per cent but that a certain volume of soil has been raised to its water-holding capacity which may be 20 per cent, the rest of the soil in the pot remaining at 8 per cent. No reference is made to the outstanding work of Frank J. Veihmeyer, *Some Factors Affecting the Irrigation Requirements of Deciduous Orchards*, Hilgardia, Vol. 2, No. 6, January 1927. The author may be pardoned for this omission, taking into consideration the title of the paper being reviewed.

The author touches upon the subject of forestation of prairies and steppes, quoting a reference to the effect that once established forests can "make their own climate." The reader interested in the subject is referred to the recent work by Benjamin Holzman, *Sources of Moisture for Precipitation in the United States*, U.S. D.A. Technical Bulletin No. 589, October 1937.

The reading of this very informative paper is recommended to all foresters, especially to those whose professional activity may have centered upon other fields. Those especially interested will appre-

ciate Dr. Raber's judicial evaluation of the work summarized, and will recognize many problems requiring investigation in addition to those which he suggests at the end of each division. His statement that "The fundamental problem for the silviculturist—the minimum amount of water necessary for the production of his crop—still remains to be solved," is a challenge to the profession.

W. U. GARSTKA,
Soil Conservation Service.



Safety for Tree Workers. By A. Robert Thompson. *U. S. Dept. Interior, National Park Service, Tree Preservation Bull. 8.* 29 pp., 12 fig. *U. S. Govt. Printing Office, Washington, D. C. 1937. Price 10c.*

This bulletin is one of a series dealing with tree problems that is intended primarily for tree workers in the National Parks. It is valuable not only because it fulfills this need but because it meets a need of all tree men. A great deal has been written on general safety but only here and there is found a meager item applying directly to tree work. This publication applies the general principles of safety to practical tree work. It is a realistic and down-to-earth publication which can be understood by both the experienced and the inexperienced tree man. The subject of safety is of utmost importance to all tree workers because of the great risks involved in everyday work. An understanding of the basic principles of safety will help reduce accidents.

The first section of the bulletin points out the necessity of safety rules in tree work and the benefits to be derived by their application. The author states that the basic rate of compensation insurance for commercial tree workers is from \$7 to \$15 per \$100 of pay rolls, depending

on the accident record. A well organized and properly administered safety program results not only in lower operating and compensation costs but also in better morale and increased efficiency, and prevents suffering and loss of earning power. A safety program consisting of 5 major parts has been set up by the National Park Service, namely: Standards, Education, Enforcement, Accident reporting, and Investigation.

The second section of the bulletin deals with rules of safe practice. The rules are an accumulation of experience and observation of many individuals and organizations over a period of many years. This section goes into great detail regarding the safety features of clothing, ropes, climbing, ladders, and pruning practices. It also treats of the dangers and necessary precautions in working around electrical

wires. Other items discussed in relation to safety are tools, tree felling, brush removal, transportation of men, spraying, fumigation, first aid, and poisonous plants. A summary of fundamental safety rules and a bibliography are presented. This is a very useful and helpful feature of the publication.

The bulletin is well written and illustrated so that foremen and tree workers can understand its contents. The illustrations show the right and the wrong methods of doing certain types of tree work. The table of weights of green logs will prove valuable to all tree workers. Although primarily intended for workers in the National Park Service, the publication should be in the hands of every tree worker.

KARL DRESSEL,
Michigan State College.



CORRESPONDENCE



DEAR DR. SCHMITZ:

In the January issue of the JOURNAL OF FORESTRY I read with great interest the editorial, "A Chapter is Ended: Another Begins." Aside from eulogizing the work of the past heads and giving them just credit they deserve, the article gives little that is definite as to what the new officers of the Society propose to do on real down-to-the-earth problems that are facing the forestry profession today. Perhaps the new executive staff members have risen so high in their work that they cannot comprehend the bewilderment of those farther down the line. May this letter serve to shed more light on a problem that seems to be glossed over so expertly by the older members of the Society and may it also serve as a challenge for immediate action by the new administration of the Society of American Foresters.

This epistle shall deal rather openly with this problem that is becoming more ominous and one that must be solved; for it deals with the lives and careers of ambitious young men who have given the best four years of their lives and several thousand dollars of their parents' money to learn the rudiments of forestry in hope that after graduation they can build a career in the forestry profession.

It would be trite to mention that during the past two years, prior to 1937, even the poorest graduate could find a place in the forestry profession if he could show his B.S. diploma; with the retrenchment of both federal and state spending for forestry purposes many of the men that had been on the staffs of forestry groups for several years have been laid off, including many J.F. appointees. What chance has even the best

of the graduates of the past two years, as well as those to graduate in the next few years, in getting an appointment when he has to "buck-up" against foresters of experience, who usually have first preference for appointments.

To show just how matters have been working out in regard to appointments, may I take the liberty of quoting a paragraph from a letter that I received from a branch of the Forest Service; this came to me in reference to appointments, "I regret that the prospects for employment at this station are not encouraging, but with curtailment of emergency funds this fiscal year it was necessary to release a number of employees whom we should very much liked to have retained." This paragraph was contained in a letter from the head of one of the branches of the Forest Service where prospects of getting an appointment are considered to be the most promising. Lest I be accused of basing a broad generality on the substance of this one paragraph, I should like to quote (for the most skeptic) paragraphs from a hundred or more letters that another forestry student and I received during our job finding campaign of last February and March. I should be glad to send these letters, which came from private, state and federal employers of foresters, to those that think my quoted paragraph is just an isolated case.

For further digression here is the record of the outstanding graduates of my class of 1937; one man is a potato inspector, one is a candy clerk, two are *teaching* forestry, one is driving an oil truck and three others that I know are unemployed; this is the illustrious record of the best men in the class. What has

happened to those that were considered as the average student of the class? At the present I do not know of one student from my class who is working for the Forest Service. I have also learned from the recent graduates of other forest schools that they and their classmates are not faring so well in the matter of appointments.

I hope that from these paragraphs the men high in the hierarchy of the forestry profession realize that the problem of employment in the forestry profession is *acute now* and that the problem must be dealt with *now* and not "sooner or later."

What remedial treatments can be applied to help solve this problem of unemployment within the ranks of the forestry profession? Dr. Korstian, the new president of the Society, in his circular letter to the members of the Society has taken a weak step by saying that "The Executive Secretary's office is endeavoring to put prospective employers and members of the Society out of employment in touch with each other." I am sure that the employers of foresters would welcome such an innovation, especially with files bulging with letters of application from foresters from every state of the Union including Canada, Mexico and the Bahama Islands.

From Mr. Guise's article on forest school enrollment it seems that this problem could best be attacked by striking a blow to the large forest school enrollments. How can this be accomplished? The most effective measure would be a complete de-emphasis of the golden opportunities for employment that one finds in the forestry profession. The best way of bringing about this de-emphasis is to show statistics as to what has been happening to recent forestry graduates as well as showing the number of J.F. appointees that have been furloughed in recent months. Printing the number of J.F.'s that have been given appointments

from the 1937 list would also prove effective.

Another remedial action would be to keep Civil Service officials from writing articles on the many openings that the Forest Service has for those that pass the Civil Service Examination. Ironical as it may seem, a month after reading the article in *The Reader's Digest* concerning the many openings with the Forest Service I read in the *New York Times* that 5,000 employees were permanently laid off from work with the Forest Service, the largest lay-off in any governmental department or bureau.

In forest schools themselves much can be done to keep down enrollments; tightening the entrance requirements, provisions for maintaining certain high scholastic averages and having the forestry professors give a true picture of the employment opportunities in the profession will do much toward keeping many students out of the forestry curriculum. In connection with forestry schools the Society itself may do much by condemning strongly the action of agricultural colleges in making the forestry schools mere puppets, stooges and Cinderellas for purposes of impressing legislative appropriation committees with large departmental enrollments.

This letter may be obtrusive to many but I hope that it may arouse the entire profession to action on a problem that must be solved *now*. Remember that you are working with disillusioned youths and their careers.

MICHAEL POCHAN, JR.,
Junior Member.



DEAR PROFESSOR CHAPMAN:

Your tables in the February S. A. F. AFFAIRS showing the employment relation in the various classifications shows how

far we have to go before private lands will be adequately covered by the work of foresters.

The picture, however, is not altogether black. Based on the August conditions federal employment had increased 119 per cent since 1934, state employment 46 per cent, educational employment 25 per cent, and private employment 67 per cent. Thus private increase was second only to federal.

I feel, however, that even these figures do not give a true picture as of today. Since August there has been material contraction of federal employment. The T.V.A., the Southern Forest Survey, the C.C.C., and other federal agencies have released a large number of employees. I do not know just how many have been picked up in private employment, but in this immediate vicinity I know of seven foresters who have left federal or state employment to accept private jobs. I think possibly a similar change has taken place through the Southern Pine Belt, so that I would venture the opinion that as of February 1938 the percentage of increase in private employment would probably equal the per cent of increase in federal employment, and would show a much greater increase over state employment than is shown by the August figures.

Another fact that must be faced is that in some instances technically trained foresters have simply not displayed the skill and ability that would make them most useful to private owners. Can it be that our foresters need more woodsmanship along with their technical training?

THOMAS W. ALEXANDER.



EDITOR, JOURNAL OF FORESTRY:

The March issue of the JOURNAL contains an article, "Forestry in our Constitutions," by Joseph S. Illick. In it

Illick awards the palm to Colorado for having been the first state in the union to mention forestry in its constitution, 1876. However, the last of the three provisions which he quotes was, I feel sure, based on the provision of the 1875 Nebraska Constitution which reads as follows:

"The legislature may provide that the increased value of lands by reason of live fences, fruit and forest trees grown and cultivated thereon shall not be taken into account in the assessment of such land for the purposes of taxation."

The origin of this provision is traceable to an act of the territorial legislature which antedates the Colorado provision by a full decade and a half.

This Nebraska provision, instead of being intended to promote forestry was rather intended to put the brakes on it, i.e., to restrict a more liberal provision of law which was then (1875) on the statute books. It came about in this way.

Samuel W. Black, Territorial Governor of Nebraska, in his first inaugural address, December 6, 1859, made an earnest plea for legislation "to encourage the planting and growth of timber." Failing to get action at that session of the legislature, he renewed and amplified his plea at the opening of the 1860-61 session. A bill was introduced shortly thereafter "to encourage the cultivation of fruit, forest, and ornamental trees," which finally passed and received the Governor's approval January 4, 1861.

This first Nebraska act approached the matter of encouraging tree planting by two different means. First, it provided that the owner of any tract of real estate in a good state of cultivation might be given an exemption thereon at the rate of \$50 for each acre on which there were planted and cultivated not less than 100 fruit or ornamental trees, or 400 forest trees in artificial groves. And, second, the act provided in substance that the cultivation of any such trees on any tract should in no case increase its valuation for revenue

purposes. This latter provision was the progenitor of the one which later was placed in the constitution. When the territorial code of 1866 came to be compiled only this second provision of the 1861 act was included. Shortly after becoming a state, however, Nebraska passed a new act (Act of February 12, 1869) reviving in modified form the broader exemption provision that had been omitted from the territorial code. By its terms the annual exemption was increased to \$100 an acre but was limited to five years and to not over \$500 for any one person owning less than 160 acres. The second provision, the one with which we here are most largely concerned, was also re-enacted but as a part of the general revenue laws.

The 5-year exemption provision proved to be unusually popular and correspondingly costly to the state in loss of needed revenue; so much so, in fact, that it nearly bankrupted the state. In the constitutional convention of 1871, therefore, there was a long and spirited debate over a proposed constitutional provision to permit the granting of tree-planting exemptions on the scale then operative under the 1869 law. The opponents, who emphasized both the excessive cost through loss of taxes and the inequity of such generous exemptions, proved strong enough to force the proponents to propose a compromise provision, namely the one already quoted above from the 1875 constitution. The entire 1871 draft of the constitution failed of ratification at that time, but it served as the basis for the draft that was submitted by the 1875 convention and adopted by popular vote.

Exemptions under the 1869 law nevertheless continued to be made in large amounts until prohibited in 1878 by a decision of the state supreme court which held the 1869 law inconsistent with the subsequently ratified constitution. This

1875 constitutional provision continued in force until 1920.

Nebraska, it may be well to recall, likes to be known as "The Tree-planter State." The name, furthermore, seems justified, judging by a recent article¹ which states that three billion forest trees were planted in the decade 1880 to 1890 when forest planting activities were at their peak. The state, furthermore, was the home of that inveterate tree planter J. Sterling Morton, the acknowledged father of Arbor Day. Morton, furthermore, was Territorial Secretary at the time Governor Black was advocating that first (1861) act, although there is no direct evidence by which actually to link Morton's well known interest in the general subject with those events. In fact, I have been told, by the author of the article above referred to, that Morton, even if he supported the idea, could hardly have approved the means since he was a strict economist, and there were several instances during the '70s when he (Morton) opposed bounties offered in the interest of agriculture and tree planting.

In the 1919-1920 constitutional convention a still further restriction upon the tree-planting exemption provision was proposed, accepted by the convention and was adopted at the special election of September 21, 1920. This new provision authorizes the legislature "to provide by general laws that the increase in value by reason of shade and ornamental trees planted along the highways shall not be taken into account in the assessment of such land." Chapter 133, Laws of 1921, approved April 26, 1921, Article II, Section 2, gives effect to this change.

Within the month, however, a letter came to me from a Nebraska authority, relative to the 1875 provision which was dropped from the constitution in 1920—18 years ago—which states:

"Our investigations show that this early

¹Jenkins, M. B. "Trees that conquered the Prairies," *Amer. Forests*, May 1937.

enactment has always been adhered to. Even to this day lands planted to timber, orchards, and vineyards are not increased in value above other like lands in the same vicinity which are not planted. This applies to our commercial orchards and vineyards as well as small plantings. I recently made a special investigation of this item in the eastern bluff areas of the state where we have very extensive orchards and vineyards."

Evidently Nebraskans feel about their constitution much as did the Tammany politician whose remark to President Cleveland about the federal constitution has become a classic, "And what's the constitution between friends?"

The Nebraska constitutional provision, it thus appears, has been about as successful in putting the brakes on forestry as the several provisions in other state constitutions which Illick quotes have been in promoting it. And anyone who is at all familiar with legislative matters knows that the public cannot readily be legislated into doing something that it has little or no interest in or, conversely, prevented by legislation from doing something it regards as worth doing. Only that legislation is vital and alive which reflects and gives expression to public convictions, rather than to the convictions of the few enthusiasts, reformers, or selfish interests, as the case may be, constituting the pressure groups who most often promote that vast amount of dead, inoperative law that now clutters up both the constitutions and the statute books of most of our states.

LOUIS S. MURPHY,
U. S. Forest Service.



EDITOR,
JOURNAL OF FORESTRY:

The March issue of the JOURNAL contained an article, "Recent State Laws on

Forestry," by Katherine Markwell, which calls for certain brief comment.

The article adds little if anything of note to the similar summary appearing on pages 25-27 of the 1937 Report of the Chief of the Forest Service, the preparation of which fell to the lot of A. B. Hastings and myself because of the resignation of the former Law Compiler of the Forest Service. That summary admittedly is almost too sketchy to be serviceable.

There was, therefore, a real need perhaps for a new, more comprehensive and more thorough-going presentation of the subject in a publication such as the JOURNAL OF FORESTRY. Such an article, however, should, I believe, have been based on the authenticated texts of the laws which have since become available in the published volumes of session laws of the states; an article backed, furthermore, by a sufficiently careful study of the earlier laws to which these 1937 laws most largely related, in order to make sure that their full import was understood. However, that much-to-have-been-desired type of amplification seems not to have been attempted but, in the main, only such amplification has been supplied as was necessary to make the earlier and rather disconnected summary read more smoothly.

Having had no opportunity myself to do any further work on the subject outside of the rather limited field of forest taxation, with which I am more especially concerned, the following comments upon specific shortcomings will be limited to that particular portion of the article:

The taxation section is introduced by the generalization that forestry experts have not agreed on the most advantageous solution of the forest tax problem. This generalization has little point since most foresters consider the subject in its more technical aspects, out of their field and hence are disinclined to dip into it except superficially. Also, it has little point

here, since of the three types of 1937 laws mentioned, one, the general severance tax laws, fall outside this specialized field of forest taxation while the other two deal only with minor phases of it.

The Arkansas and New Mexico severance tax laws mentioned are hardly correctly or adequately described by saying that either state "*provided* a severance tax on timber" in 1937. Arkansas provided its general severance tax on all natural resources, including oil, natural gas, bauxite and other minerals, and timber, in 1923. This was a strictly revenue measure, having no relation whatever to forestry or forest taxation as commonly understood and having as a matter of fact little or no indirect effect upon either. What the legislature did in 1937 was simply to earmark for the support of state forest work such of the revenue under that 1923 act, and subsequent amendments, as might thereafter be derived from the tax on timber, setting up for the purpose a "State Forestry Fund" to which such revenue would be credited, and then proceeded to make appropriations for the fiscal years 1938 and 1939.

The 1937 New Mexico severance tax law was likewise a general revenue law, and provided severance taxes on gold, silver, copper and other minerals commonly found in the state as well as timber. Indeed a careful study of the wording of the law seems to indicate, at least so far as timber is concerned, that it probably was more especially intended to reach by taxation the timber cut from publicly owned land where much, if not most of the commercially valuable timber in New Mexico is to be found. Thus the tax is declared to be in addition to the property tax, not in lieu of it, and is to be levied on the *severed* value of the various mineral and timber products and not upon their value before severance as is usual under a forest tax law. Furthermore, the operator who severs or the one who first purchases the products after

severance rather than the land owner (unless the owner is also the operator) is the one made liable for the tax. And finally the law provides that "in computing the amount of said tax there shall be deducted from the gross value of said products the value * * * due or paid to the United States of America or the State of New Mexico * * * for and as rent or royalty payments." In other words, the law on its face has little if any bearing upon forestry.

As for the Alabama law referred to, the article again misses the point. The state actually "deferred taxation on auxiliary state forest timber" in 1923. Furthermore, the 1937 amendment had no relation whatever to the deferment of taxes on such timber. It provided that any Alabama corporation subject to a tax (franchise tax presumably), based on the value of its shares of capital stock, could deduct from the value of such shares for the purpose of such tax, the value of any timber it might have on lands classified as auxiliary state forest. In other words the privilege granted thereby was an exemption from, not a deferment of, tax.

The Wisconsin farm woodland exemption law referred to, carries the implication that this was new in 1937, whereas it was most largely a reenactment in simplified form of a 1935 law. This simplification did, however, introduce an important new feature. It did away with any formal classification procedure and provided for an outright grant of exemption based on a few simple criteria the assessor can recognize. Omitted, on the other hand, was any reference to another 1937 Wisconsin law which made rather sweeping changes in the so-called forest crop (tax) law and a companion law relating to county forests which have been classified under this forest crop law. The changes are not such as to lend themselves readily to brief, concise description. In part, at least, they aim to discourage counties that have county forests classified under the

forest crop law, and for which the state has provided aid, from disposing of part of them in such a way as to disrupt their essential unity for forest management purposes.

Omitted, too, was any reference to the tax exemption provision in the 1937 Idaho law relating to cooperative sustained yield districts, although the other features of the law were elsewhere summarized. The importance of this exemption feature may turn out to be such as to make it "the tail that wagged the dog."

Also omitted, was any reference to a tree-planting bounty law passed by North Dakota, although reference was made, in

another place, to the fact that South Dakota had amended its similar bounty law. While bounty laws, like exemption and rebate laws which seek to promote tree planting, are not strictly forest taxation, yet they modify taxation as otherwise imposed and are not infrequently tied up to taxation in such other ways as not readily to be disentangled therefrom. For these reasons such bounty and similar class of laws have for a generation or more been included in any discussion of the subject of forest taxation.

LOUIS S. MURPHY,
U. S. Forest Service.

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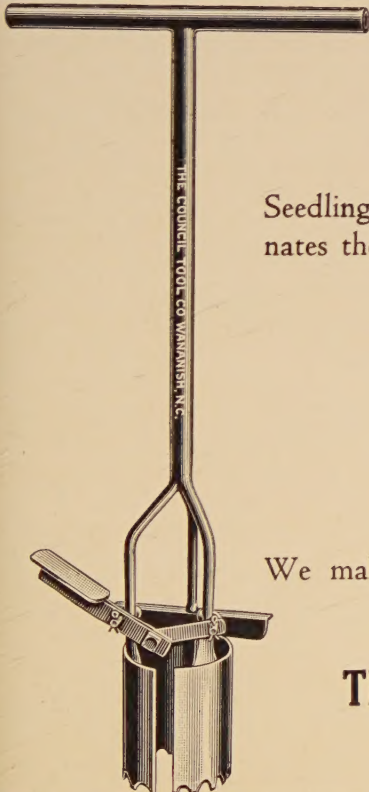
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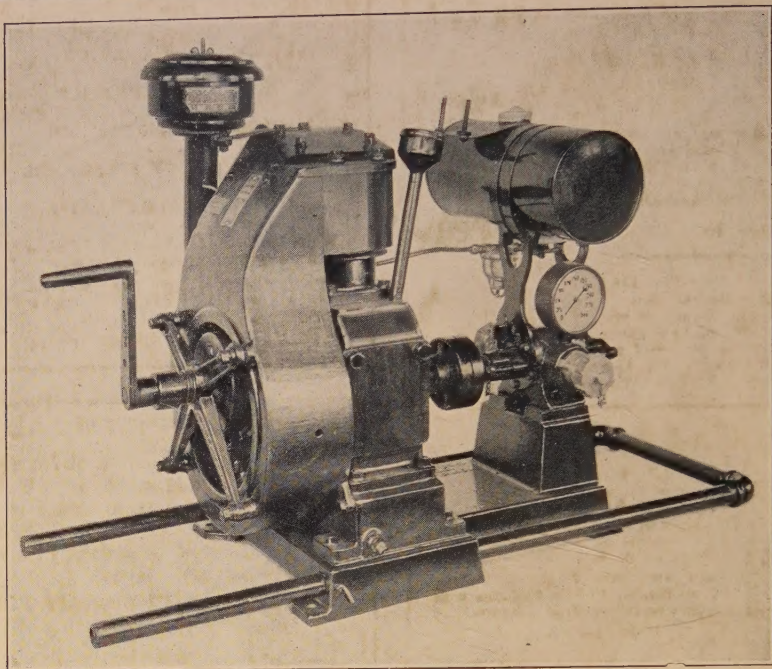
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